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Monterey, California 93943-5138

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Thesis Abstracts

September 2005

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PREFACE

This publication contains abstracts of unrestricted or unclassified theses submitted for the degrees doctor of philosophy, master of business administration, master of science, and master of arts for the September 2005 graduation. Classified and restricted distribution abstracts are listed on the NPS SIPRnet.

This compilation of abstracts of theses is published in order that those interested in the fields represented may have an opportunity to become acquainted with the nature and substance of the student research that has been undertaken. Copies of theses are available for those wishing more detailed information. The procedure for obtaining copies is outlined on the last page of this volume.

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http://www.nps.navy.mil/Research/thesisyr.html

INTRODUCTION

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Mission
The Naval Postgraduate School (NPS) was established to serve the advanced educational needs of the Navy. The broad responsibility of the school is reflected in its stated mission:

> Increase the combat effectiveness of U.S. and allied armed forces and enhance the security
> of the U.S.A. through advanced education and research programs focused on the technical,
> analytical, and managerial tools needed to confront defense related challenges of the future.

To fulfill its mission, the Naval Postgraduate School strives to sustain excellence in the quality of its instructional programs, to be responsive to technological change and innovation in the Navy, and to prepare officers to introduce and utilize future technologies.
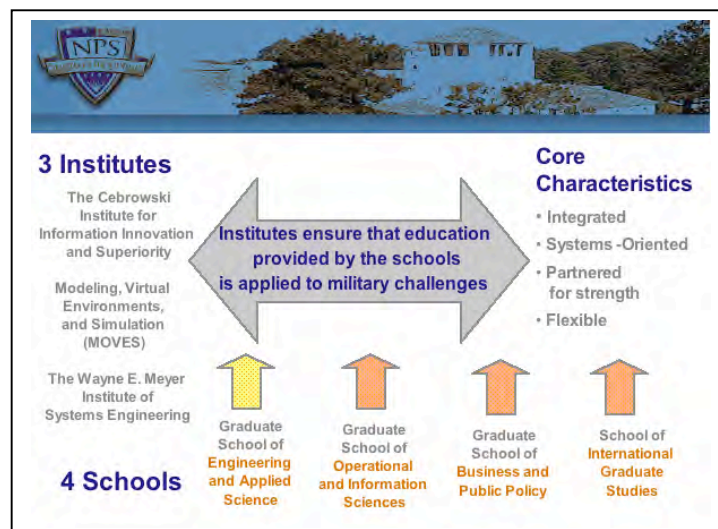
The research program at NPS exists to support the primary mission of graduate education. Research at NPS:
- maintains upper division course content and programs at cutting edge;
- challenges students with creative problem solving experiences on DoD relevant issues;
- advances DoN/DoD technology;
- solves warfare problems; and
- attracts and retains quality faculty.

Academic Programs
To meet its educational requirements, the Navy has developed a unique academic institution at the Naval Postgraduate School through the use of specially tailored academic programs, and a distinctive organization tying academic disciplines to naval and joint warfighting applications.

The Naval Postgraduate School has aligned its education and supporting research programs to achieve three major goals: 1) academic programs that are nationally recognized and support the current and future operations of the Navy and Marine Corps, our sister services, and our allies; 2) institutes that focus on the integration of teaching and research in direct support of the four pillars of Joint Visions 2010 and 2020 and their enabling technologies; and, 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer's career.

INTRODUCTION

Programs of graduate studies at NPS are grouped as follows:

Graduate School of Operational and Information Sciences
- Computer Science
- Computer Technology
- Electronic Warfare Systems, International
- Human Systems Integration
- Information Sciences
- Information Systems and Operations
- Information Systems and Technology
- Information Warfare
- Joint C4I Systems
- Joint Information Operations
- Modeling, Virtual Environments, and Simulation
- Operations Analysis
- Operations Logistics
- Software Engineering
- Space Systems Operations
- Space Systems Operations, International
- Special Operations and Irregular Warfare

Graduate School of Engineering and Applied Sciences
- Applied Mathematics
- Combat Systems Science and Technology
- Electrical Engineering
- Electronic Systems Engineering
- Engineering Acoustics
- Mechanical and Astronautical Engineering
- Meteorology
- Meteorology and Oceanography
- Oceanography
- Operational Oceanography
- Space Systems Engineering
- Systems Engineering
- Systems Engineering and Analysis
- Undersea Warfare
- Systems Engineering Management, Product Development
- Undersea Warfare, International

Graduate School of Business and Public Policy
- Acquisition and Contract Management
- Defense Systems Analysis
- Defense Systems Management, International
- Executive Management
- Financial Management
- Information Systems Management
- Leadership Education and Development
- Logistics and Transportation Support Management
- Manpower Systems Analysis
- Program Management
- Resource Planning and Management for International Defense
- Supply Chain Management
- Systems Acquisition Management
- Transportation Management

School of International Graduate Studies
- Civil-Military Relations
- Defense Decision Making and Planning
- Homeland Security
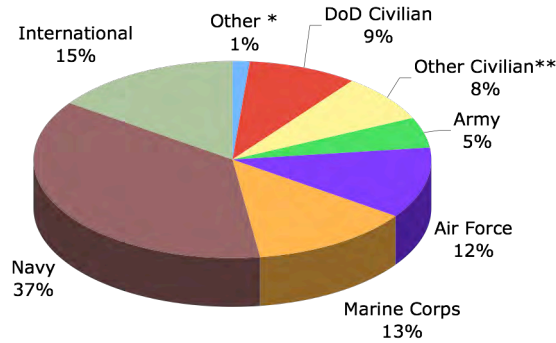- Security Studies: Stabilization and Reconstruction

National Security and Intelligence:
- Europe/Russia/Central Asia
- Far East/Southeast Asia/Pacific
- Middle East/Africa/South Asia
- Western Hemisphere

Students

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government and military officers and government civilian employees of other countries. Resident degree/subspecialty student population for September 2005 is shown in Figure 1 on the following page.

Figure 1: Resident Degrees/Subspecialty Student Population for September 2005
(Total Enrollment: 1,457)
* U.S. Coast Guard, Air National Guard   **Department of Homeland Defense, Department of Health and Human Services, Federal Bureau of Investigation, New York City Fire Department, Tampa Fire Rescue, Los Angeles Sheriff's Department, Washington D.C. Police Department, Ventura (California) Police Department, Douglas County (Nebraska) Sheriff's Office, Montgomery County (Maryland) Police Department

Academic Degrees

Although the curricula are tailored to address defense requirements, they are developed within the framework of classical academic degrees, meeting the highest academic standards. Each curriculum leads to a Master's degree; however, additional study can lead to either an engineer's degree or the doctor's degree. Below is a listing of the degrees offered at NPS:

Master of Arts Degrees
National Security Affairs
Security Studies

Master of Business Administration

Master of Science Degrees
Applied Mathematics
Applied Physics
Applied Science
Astronautical Engineering
Combat Systems Technology
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Engineering Science
Human Systems Integration
Information Operations
Information Systems and Operations
Information Technology Management
Leadership and Human Resource Development
Management
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Physics
Product Development

Program Management
Software Engineering
Space Systems Operations
Systems Engineering
Systems Engineering Management
Systems Technology

Engineer's Degrees
Astronautical Engineer
Electrical Engineer
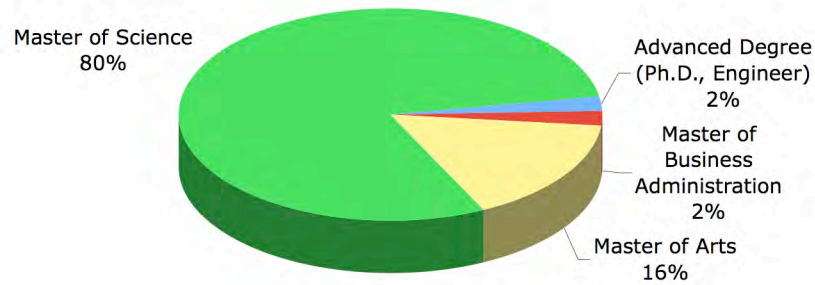Mechanical Engineer

Doctor of Philosophy
Applied Mathematics
Applied Physics
Astronautical Engineering
Computer Science
Electrical Engineering
Engineering Acoustics
Information Science
Mechanical Engineering
Meteorology
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
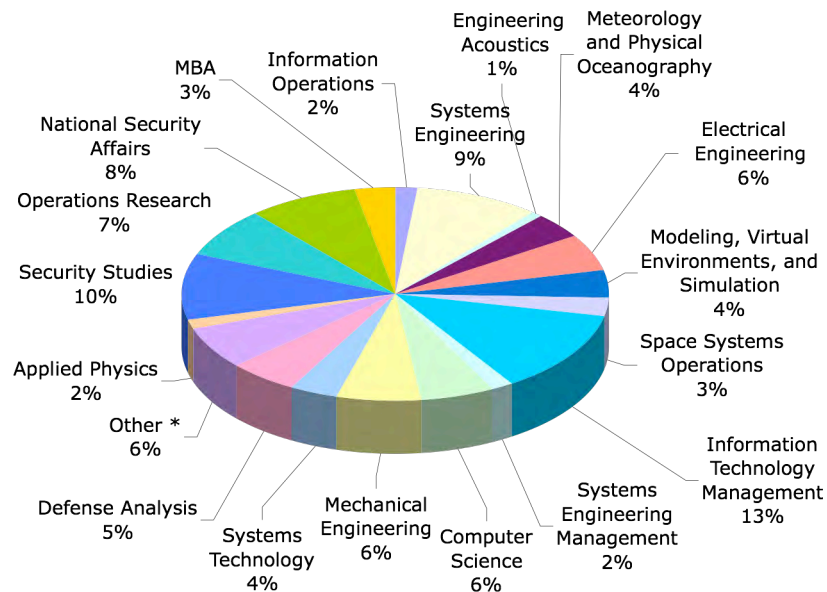Physics
Software Engineering

Doctor of Engineering
Astronautical Engineering
Engineering Acoustics
Mechanical Engineering

INTRODUCTION

There were 226 degrees conferred in September 2005. Figure 2 indicates the distribution of degree type; Figure 3 indicates the degree conferred.

Figure 2. Distribution by Degree Type
(226 Degrees Conferred)

Figure 3. Degrees Conferred In September 2005
(226 Degrees Conferred)

*Other: Ph.D. Electrical Engineering (2), Ph.D. Computer Science (1) Electrical Engineer (1), Ph.D. Modeling, Virtual Environments, and Simulation (1), M.S. Astronautical Engineering (2), M.S. Information Systems and Operations (1), M.S. Product Development (1), M.S. Physics (2), M.S. Engineering Science (2), M.S. Human Systems Integration (1), , M.S. in Physical Oceanography (2), M.S. Software Engineering (2)

Theses

The thesis is the capstone achievement of the student's academic endeavor at NPS. Thesis topics address issues from the current needs of the Fleet and Joint Forces to the science and technology that is required to sustain long-term superiority of the Navy/DoD.

Students, with their faculty advisors, provide a very unique capability within the DoD for addressing warfighting problems. This capability is especially important at the present time when technology in general, and information operations in particular, are changing rapidly. Our officers must be able to think innovatively and have the knowledge and skills that will let them apply technologies that are rapidly being developed in both the commercial and military sectors. Their unique knowledge of operations, when combined with a challenging thesis project which requires them to apply their focused graduate education, is one of the most effective methods for both solving Fleet/Joint Force problems and instilling the life-long capability for applying basic principles to the creative solution of complex problems.

NPS is unique in its ability to conduct classified research. Restricted theses are available on the NPS SIPRNET.
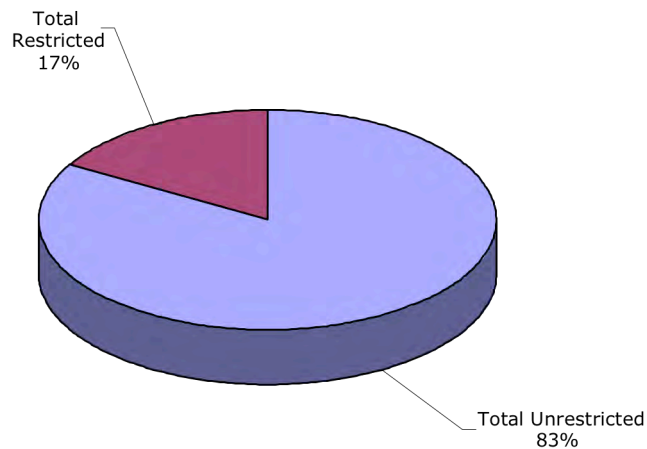

Figure 4. Classification of Theses

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ADVANCED DEGREES

Doctor of Philosophy
Electrical Engineer

DOCTOR
OF
PHILOSOPHY

APPLYING DOUBLY LABELED TRANSITION SYSTEMS TO THE REFINEMENT PARADOX

David L. Bibighaus-Major, United States Air Force
B.S., United States Air Force Academy, 1994
M.S., University of California-Los Angeles, 1998
Doctor of Philosophy in Computer Science-September 2005
Committee: George W. Dinolt, Department of Computer Science
Cynthia E. Irvine, Department of Computer Science
Sylvan Pinsky, National Security Agency
Mikhail Auguston, Department of Computer Science
Timothy E. Levin, Department of Computer Science

Possibilistic Security Properties are widely used in the development of high-assurance security models. However, while a model may possess a security property, an implementation of the model is not guaranteed to possess the property. The authors argue that the choice of a framework, and its associated definition of refinement, is critical to ensure that an implementation maintains the security property. The authors show how to use doubly labeled transition systems to reason about possibilistic security properties and refinement. This framework is compared to three other process algebras frameworks and the authors show how the framework and security model preserves the security of the largest class of systems is shown. As a consequence of this framework, this research shows how security property links confidentiality to availability.

KEYWORDS: Security, Information Flow, Formal Methods, Refinement, High Assurance

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THEORY OF MULTIRATE STATISTICAL SIGNAL PROCESSING AND APPLICATIONS

Ryan J. Kuchler-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1993
M.S., Naval Postgraduate School, 2002
Doctor of Philosophy in Electrical Engineering-September 2005
Advisor: Charles W. Therrien, Department of Electrical and Computer Engineering

This dissertation develops basic theory and applications of statistical multirate signal processing. Specific tools and terminology for describing multirate systems in the time and frequency domains are presented. An optimal multirate estimator is derived in both a direct form and recursive form. The recursive form of the optimal estimator allows calculation of the relative change in performance when input signals are added or removed from the multirate system. The optimal multirate filtering problem is also specialized to the case of optimal multirate linear prediction. An efficient method for calculating the multirate linear prediction coefficients and error variances is developed through the use of the multichannel Levinson recursion and generalized triangular UL factorization. Finally, a multirate sequential classifier is derived and applied to the problem of target classification. It is shown that classifier parameters needed for implementing the multirate sequential classifier are the same as those for multirate linear prediction. The methods presented in this dissertation are useful for multisensor fusion, particularly when the sensors are operating at different rates.

KEYWORDS: Multirate Statistical Signal Processing, Linear Estimation, Linear Prediction, Classification

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**THEORY OF MULTIRATE SIGNAL PROCESSING WITH APPLICATION TO SIGNAL AND
IMAGE RECONSTRUCTION**
James W. Scrofani-Commander, United States Navy
B.S., University of Florida, 1987
M.S., Naval Postgraduate School, 1997
Doctor of Philosophy in Electrical Engineering-September 2005
Advisor: Charles W. Therrien, Department of Electrical and Computer Engineering

Signal processing methods for signals sampled at different rates are investigated and applied to the problem of signal and image reconstruction or super-resolution reconstruction. The problem is approached from the viewpoint of linear mean-square estimation theory and multirate signal processing for one- and two-dimensional signals. The author takes a new look at multirate system theory in one and two dimensions, which provides the framework for these methodologies. A careful analysis of linear optimal filtering for problems involving different input and output sampling rates is conducted. This results in the development of index mapping techniques that simplify the formulation of Wiener-Hopf equations whose solution determine the optimal filters. The required filters exhibit periodicity in both one and two dimensions, due to the difference in sampling rates. The reconstruction algorithms developed are applied to one- and two-dimensional reconstruction problems.

KEYWORDS: Multirate Signal Processing, Super-Resolution, Optimal Filtering, Number Theory, Image Reconstruction

**GENERATING ENHANCED NATURAL ENVIRONMENTS AND TERRAIN FOR
INTERACTIVE COMBAT SIMULATIONS (GENETICS)**
William D. Wells-Major, United States Air Force
B.A., Georgia Institute of Technology, 1991
M.S., Air Force Institute of Technology, 1996
Doctor of Philosophy in Modeling, Virtual Environments, and Simulation-September 2005
Advisor: Rudolph Darken, Department of Computer Science

Virtual battlefields devoid of vegetation deprive soldiers of valuable training in the critical aspects of terrain tactics and terrain-based situational awareness, but creating realistic landscapes by hand is notoriously expensive, requiring both proprietary tools and trained artists, hampering rapid scenario generation and limiting reuse.

GENETICS is a new object placement scheme where the arduous task of placing vegetation objects is reduced to finding readily available source data and setting a few parameters. This approach constructs large-scale natural environments at run-time using a procedural image-based algorithm without the need for skilled artists or proprietary tools. The resulting vegetation-laden terrain looks realistic, and the algorithm can be extended to incorporate a wide variety of environmental factors. GENETICS offers researchers the ability to quickly and easily build consistent large-scale synthetic natural environments to examine vegetation clutter requirements necessary to accomplish distributed mission training tasks.

This dissertation presents and implements the GENETICS algorithm, compares it against other vegetation placement schemes and outlines how simulationists can use GENETICS to quickly and cheaply build large-scale natural environments. It also touches upon level of detail algorithms, ecotype modeling and how GENETICS can be used to generate land cover data where none exists.

KEYWORDS: Terrain Visualization, Vegetation Placement, Virtual Landscapes, Synthetic Natural Environments, Real-Time Simulation, Ecotype Modeling

ELECTRCAL ENGINEER

DESIGN AND ANALYSIS OF A MULTICOLOR QUANTUM WELL INFRARED PHOTODETECTOR
Fabio Durante Pereira Alves-Major, Brazilian Air Force
B.S., Instituto Tecnologico de Aeronautica, 1997
Master of Science in Electrical Engineering-September 2005
Electrical Engineer-September 2005
Advisors: Gamani Karunasiri, Department of Physics
John Powers, Department of Electrical and Computer Engineering
Sherif N. Michael, Department of Electrical and Computer Engineering

Recent military applications have demanded photodetectors with high sensitivity, high selectivity and multispectral capability for detection and identification of the target. These characteristics have been found in quantum well infrared photodetectors (QWIP). Driven by these applications, a QWIP photodetector capable of detecting simultaneously infrared emissions within near infrared (NIR), mid wavelength infrared (MWIR) and long wavelength infrared (LWIR) is studied, modeled, designed and characterized. Using the envelope function approximation, the mathematical model of the quantum phenomena in semiconductor heterostructures is derived. A computational tool is developed to solve self-consistently the Schodinger-Poisson equation using the shooting method, allowing the theoretical evaluation of the absorption coefficient. A three-color (NIR, MWIR and LWIR) GaAs-based QWIP sample and a two-color (NIR and MWIR) InP-based QWIP sample are designed, both comprised of stacks of uncoupled wells for each band detection. The 67 layers of the GaAs sample are grown using molecular beam epitaxy (MBE). Intersubband absorption in the sample was measured for the MWIR and LWIR using Fourier transform spectroscopy (FTIR) and the measured peak positions, found at 5.3 meters, 8.7 meters and 13.8 meters are within 0.3 meters of the theoretical values, indicating that the model accurately predicts the absorption wavelengths. A two-dimensional ordered grating pattern are selected and optimized separately for both MWIR and LWIR desired peaks. Finally, the photodetector device configurations are designed to permit to the measurement of the NIR band through photocurrent spectroscopy and performance analysis. The fabrication and characterization of the prototypes are a matter for future work.

KEYWORDS: Quantum Well, QWIP, Three-Color Detection, Infrared Detection, Self-Consistent Shrodinger-Poisson Solution, Absorption, FTIR

MASTER
OF
BUSINESS ADMINISTRATION

MASTER OF BUSINESS ADMINISTRATION

**BEYOND MILITARY SERVICE: AN ANALYSIS OF UNITED STATES NAVAL ACADEMY
GRADUATES' CIVILIAN CAREER EXPERIENCES**
Jeanette M. Bederman-Lieutenant, United States Navy
B.S., Vanderbilt University, 1999
Master of Business Administration-September 2005
Advisors: Stephen L. Mehay, Graduate School of Business and Public Policy
William R. Bowman, U.S. Naval Academy

This thesis explores the civilian career experiences of United States Naval Academy (USNA) graduates who have left military service. The data analyzed comes from a 2004 survey of USNA graduates from the classes of 1986 through 1996. This thesis analyzes the effect of human capital accumulated via the USNA education, via follow-on military experiences and via career preparation on civilian salary and satisfaction. Both the first salary after leaving the military service and the current salary are analyzed. Both salary models find that varsity athletes, honors graduates, submariners and those who achieved higher military ranks earn more than their classmates. Military tenure increases civilian salary, but the effect diminishes after a certain point. Selective Reservists consistently earn lower civilian salaries. Write-in responses reveal that leadership, academics, time management and other personal skills provide the most influential USNA experiences on current civilian jobs. While 84 percent describe themselves as satisfied, a satisfaction model is estimated to examine for trade-offs between salary and satisfaction. Satisfaction is further examined by evaluating the effect of civilian accomplishments. The estimates find that Marines, Naval aviators and Trident Scholars are more likely to be dissatisfied than satisfied. Military tenure yields a tradeoff between wages and satisfaction.

KEYWORDS: Manpower, Salary, Satisfaction, Military to Civilian, Naval Personnel, United States Naval Academy, Career Experiences After USNA Survey, Gender Gap, Family Gap

PSYCHOLOGICAL CONDITIONS AND ATTRITION FROM U.S. NAVY RECRUIT TRAINING
Monica R. Farr-Lieutenant Commander, United States Navy
B.A., Johnson C. Smith University, 1994
Master of Business Administration-September 2005
Michael J. Snowden-Lieutenant, United States Navy
B.S., University of Southern California, 2000
Master of Business Administration-September 2005
Advisors: Mark J. Eitelberg, Graduate School of Business and Public Policy
Stephen L. Mehay, Graduate School of Business and Public Policy

This thesis examines information on attrition from the Navy's Recruit Training Center (RTC) for psychological reasons. This information is based on an analysis of the PRIDE and CETARS databases, in addition to the interpretation of an RTC Legal Department database. A total of 227,842 PRIDE records, 233,152 CETARS records and 4,279 Legal recruit records are analyzed. These records are used to validate the psychological attrition numbers uncovered in previous studies, to critique information presented in the CETARS and PRIDE databases and to discover what specific psychological disorders were the actual cause of the majority of attrition at RTC. The results from the PRIDE and CETARS databases indicate that from fiscal year 2000 through 2004, over 36 percent of all attrition was due to psychological reasons. It further shows that the pre-service categories of Personality Disorder and Pre-Service Psychological account for nearly 90 percent of this attrition. The analysis of the Legal database indicates that over 85 percent of the diagnoses fell into the categories of Personality Disorder, Adjustment Disorder, Depressive Disorder and Attention Deficit/Hyperactivity Disorder. The authors conclude that the psychological attrition categories in the PRIDE and CETARS databases are too broad for specific interpretation of RTC recruit information and construction of a new database is recommended

KEYWORDS: Recruits, Recruit Training Command Attrition Rate, RTC Attrition Rate, Psychological Conditions, Mental Conditions, Boot Camp Attrition

MASTER OF BUSINESS ADMINISTRATION

RESTRUCTURING THE UNITED STATES NAVY CHAPLAIN CORPS
Kenneth G. Harris-Lieutenant, United States Navy
B.A., San Diego State University, 2000
Master of Business Administration-September 2005
Advisor: David R. Henderson, Graduate School of Business and Public Policy
Second Reader: Nicholas Dew, Graduate School of Business and Public Policy

The Department of Defense has scarce resources and must continually make decisions on what new programs to fund and what obsolete/unnecessary programs to eliminate or modify. With regard to manpower issues, there are many jobs within the military that could be outsourced or restructured for a financial savings without a reduction in quality. One of these potential jobs is that of the U.S. Navy chaplain. This paper investigates (1) whether or not this function must necessarily be performed by a commissioned officer and (2) whether a substantial savings could be realized to the United States taxpayer without sacrificing any of the rights of religious freedom.

Overall, an argument is made for the divestiture of permanent shipboard and most shore-based chaplains. This is done on the basis of economic savings (potentially $69 million/year) and the lack of a demonstrated necessity for religious representation in areas that provide sufficient opportunities for worship. Outsourcing is presented as another avenue to obtain financial savings (potentially $37.5 million/year) due to the demonstrated lack of difference between the duties of military chaplains and civilian clergy. However, outsourcing is shown to be an inferior approach. Additionally, the logic behind the preservation of the Chaplain Corps is explored.

KEYWORDS: U.S. Navy Chaplain Corps, Military Chaplains, Pluralism, Outsourcing, A-76, Strategic Sourcing, Cost Benefit Analysis, Cost Effectiveness Analysis, Special Interest Groups

THE RETURNS TO HUMAN CAPITAL MIGRATION WITHIN THE DEPARTMENT OF DEFENSE CIVILIAN INTERNAL LABOR MARKET
Miguel S. Macias-Lieutenant, United States Navy
B.A., University of Houston, 1999
Master of Business Administration-September 2005
Advisor: Elda Pema, Graduate School of Business and Public Policy
Second Reader: Stephen L. Mehay, Graduate School of Business and Public Policy

Researchers examine the returns to mobility of civilian personnel within the Department of Defense (DoD). This study employs panel data provided by the Defense Manpower Data Center (DMDC) and drawn from the Department of Defense Civilian Personnel Data Files. The dataset consists of 21,143 personnel who were new hires in years 1994-1995. Between 1994-1995 and 2003, 3,267 (15.4%) employees were interstate migrants. The data are set up as an unbalanced panel with a total of 132,068 observations. This study uses ordinary least squares (OLS), probit and Heckman selection-correction techniques to explore two returns to mobility measures: compensation and promotion. Multivariate models are specified and estimated for each performance measure. The results indicate that workers who migrate are more likely subsequently to be promoted. Migration is a strategic move for workers to advance and maximize their personal utility since migrants earn higher salaries than non-migrants. Females present no evidence of tied-mover effects, and pursue promotion and salary opportunities like males. Women promote faster than men, and women migrants increase their promotion rates even more. Females, however, earn lower salaries than males. The models also reveal that veterans earn lower salaries than non-veterans and have no significant advantages in promotion over their counterparts.

KEYWORDS: Migration, Mobility, Human Capital, Compensation, Promotion

MASTER OF BUSINESS ADMINISTRATION

APPLIED WARFIGHTER ERGONOMICS: A RESEARCH METHOD FOR
EVALUATING MILITARY INDIVIDUAL EQUIPMENT
Koichi Takagi-Captain, United States Marine Corps
B.S., University of Arizona, 1999
Master of Science in Operations Research-September 2005
Master of Business Administration-September 2005
Advisor: Nita Lewis Miller, Department of Operations Research
Second Reader: Nicholas Dew, Graduate School of Business and Public Policy

Design and implement a laboratory and establish a research method focused on scientific evaluation of human factors considerations for military individual equipment under both laboratory and field conditions. This integrated approach for laboratory and field conditions is the first of its kind for military human factors research, enabling an unparalleled degree of scientific rigor in the collection of empirical human factors data. This effort includes: 1) a state-of-the-art usability laboratory designed specifically for quantitatively evaluating military individual equipment; 2) a rugged, embarkable, fully self-contained, portable usability laboratory for field research in military environments; 3) a codified manual for using the two main configurations (stationary and portable) of the usability laboratory, written for the beginning usability researcher; 4) a set of validated procedures for applying sound human factors principles, and traditional and non-parametric statistics to the specific problem of usability testing of military individual equipment; 5) a proof-of-concept practical application of the laboratory and procedures to a specific problem, namely the usability testing of ruggedized personal digital assistants (RPDAs) designed for United States Special Forces operations.

KEYWORDS: Devices, Ergonomics, Handheld, Human Factors, Individual Equipment, Noldus, Observer, PDA, Personal Digital Assistant, RPDA, Usability, Usability Laboratory, Usability Testing

MASTER OF SCIENCE

Applied Physics
Astronautical Engineering
Computer Science
Defense Analysis
Electrical Engineering
Engineering Acoustics
Engineering Science
Human Systems Integration
Information Operations
Information Technology Management
Management
Mechanical Engineering
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Physics
Software Engineering
Space Systems Operations
Systems Engineering
Systems Engineering Management
Systems Technology

MASTER OF SCIENCE
IN
APPLIED PHYSICS

INVESTIGATIONS OF NONLINEAR WAVES AND PARAMETRIC EXCITATION

William P. Jones-Ensign, United States Navy
B.S., United States Naval Academy, 2004
Master of Science in Applied Physics-September 2005
Advisor: Bruce Denardo, Department of Physics
Second Reader: Thomas Hofler, Department of Physics

Nonlinearity in oscillations and waves can lead to dramatic and useful behavior. The course PH4459 at the Naval Postgraduate School was redesigned to extend its original subject of nonlinear acoustics to nonlinear oscillations and waves in general, with minimal prerequisites for non-acoustics-tracked students. Due to the unusual behavior and mathematical difficulty of nonlinear systems, lecture demonstrations are vital to the course. This thesis develops two new demonstrations for the course and improves an existing demonstration. In one new demonstration, the generation and detection of high-amplitude waves on water is investigated to demonstrate the dependence of the wave speed upon amplitude. The experimental data agree with the theory. In the other new demonstration, a compression driver that exhibits a strong response at half the frequency of the drive is investigated. Data and the current scientific literature indicate that this behavior is due to parametric excitation of the deformation modes of the diaphragm assembly. Finally, improvements to a torsional oscillator that is parametrically excited by modulation of its length are described. The improvements include a new motor, sturdier construction and a new torsional strip.

KEYWORDS: Nonlinear Waves, Parametric Excitation, Gravity Waves, Capillary Waves, Torsional Oscillator

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DIRECT IMAGING OF MINORITY CHARGE CARRIER TRANSPORT IN LUMINESCENT SEMICONDUCTORS

David R. Luber-Captain, United States Marine Corps
B.S., University of Colorado at Boulder, 1999
Master of Science in Space Systems Operations-September 2005
Master of Science in Applied Physics-September 2005
Advisor: Nancy M. Haegel, Department of Physics
Second Reader: Sherif N. Michael, Department of Electrical and Computer Engineering

A quantitative method for extracting minority carrier diffusion and drift lengths is developed and demonstrated in a heavily-doped semiconductor heterostructure. This method advances the high-resolution transport imaging technique, yielding key material parameters with a single, non-destructive measurement. This is the first demonstration of a scanning-electron-microscopy (SEM)-based, contact-free, non-destructive technique for high-resolution minority carrier lifetime measurement. The measured values are in excellent agreement with theoretical calculations.

The imaging transport technique is also employed to image the nature of the generation region as a function of beam energy, probe current and sample atomic number. These types of images should be useful to allow for experimental verification of resolution limits in cathodoluminescence (CL) and electron-beam-induced current (EBIC) associated with interaction volume effects in bulk materials and can be obtained without additional sample preparation.

Finally, several suggestions for further research are offered, including mapping of radiation damage in solar cells, near-contact E field mapping and studies of low-dimensional structures such as superlattices and quantum wires. These nanoscale structures are poised to usher in the next revolution in solid-state electronic devices.

APPLIED PHYSICS

KEYWORDS: Contact-Less Measurements, Diffusion, Drift, Semiconductors, Transport Imaging, Minority Carrier Mobility, Minority Carrier Lifetime, Generation Volume

MODELING OF LOW TEMPERATURE C-V PROFILING IN BLOCKED IMPURITY BAND DETECTORS

Steven J. Tschanz-Ensign, United States Naval Reserve
B.S., University of Notre Dame, 2004
Master of Science in Applied Physics-September 2005
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Second Reader: Donald L. Walters, Department of Physics

Silicon Blocked Impurity Band (BIB) detectors are state-of-the-art devices to detect light in the near to mid infrared range (5-40 μ m). Numerical modeling of BIB detectors is performed using a four-region finite difference approach to study the role of space charge in C-V (capacitance-voltage) profiling of minority carrier doping and the role of blocking layer thickness and minority doping concentration in an alternative bias scheme. Compensation in the blocking layer is found to play a critical role in determining the net voltage drop in this part of the device under alternate polarity bias. The effect of space charge at the blocking layer/active layer interface on the measured low temperature C-V distribution is modeled as a function of the doping interface between the two layers. The magnitude of the space charge can cause large deviations in the measurement of minority doping concentration from the idealized case, which assumes a space-charge free blocking layer and interface. Accurately determining these minority doping concentrations is a crucial step toward solving material growth challenges in proposed far infrared Ge and GaAs devices.

KEYWORDS: Blocked Impurity Band, BIB, Impurity Band Conduction, IBC, Infrared Detector, Infrared Sensor, Long Wavelength Infrared, LWIR, Very Long Wavelength Infrared, VLWIR, C-V Profiling, Low Temperature C-V Profiling, Minority Doping Concentration

MASTER OF SCIENCE
IN
ASTRONAUTICAL ENGINEERING

**EVALUATION AND SELECTION OF AN EFFICIENT FUEL/AIR INITIATION STRATEGY
FOR PULSE DETONATION ENGINES**
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Rapid and efficient initiation of hydrocarbon/air mixtures has been identified as one of the critical and enabling technologies for Pulse Detonation Engines (PDEs). Although the Naval Postgraduate School (NPS) Rocket Propulsion Laboratory has successfully demonstrated fuel/air detonations in a valveless pulse detonation engine using ethylene, propane and JP-10 fuels, past engine designs have relied upon a sensitive fuel/oxygen initiator unit to initiate the less sensitive fuel/air mixtures. To realize the increased thermodynamic efficiencies of PDEs and thus compete with ramjets and other supersonic platforms, it is imperative to eliminate any need for supplementary oxygen in an air-breathing PDE design. This thesis examines ignition technologies and initiator designs that did not require auxiliary oxygen, including capacitive discharge systems and the developing technology of Transient Plasma Ignition (TPI). The current NPS pulse detonation engine architecture is modified to evaluate the various ignition strategies in a PDE operating on an ethylene/air mixture at simulated supersonic cruising conditions. Comparisons are based upon ignition success rate, ignition delay time, detonation wave speed and Deflagration-to-Detonation (DDT) distance. Reliability and performance of the TPI system proves to be superior to conventional ignition systems. Furthermore, successful initiation of a PDE operating at a frequency of up to 40 hertz is demonstrated without the use of supplementary oxygen.

KEYWORDS: Pulse Detonation Engines, PDE, PDE Ignition, PDE Initiation, Transient Plasma Ignition, TPI

MASTER OF SCIENCE
IN
COMPUTER SCIENCE

TAXONOMY OF SPYWARE AND EMPIRICAL STUDY OF NETWORK DRIVE-BY DOWNLOADS

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Spyware has rapidly become a major security concern in government and corporate networks and for home computers. Spyware is able to circumvent common security practices, funneling information to remote parties and consuming system resources with impunity. This malicious software has infiltrated common search engines and Internet sectors generally considered "safe." Making use of browser vulnerabilities, spyware infection is widespread.

This thesis considers common infection vectors and reviews current definitions in arriving at an improved definition of spyware. It identifies four common activities present in all spyware, which lead to multiple behavioral capabilities. An empirical analysis of network drive-by downloads shows the presence of spyware in bank, online travel and real estate-related Internet sectors. The impact of system security patch maintenance on spyware susceptibility and browser differences in the context of drive-by-downloads is also presented.

KEYWORDS: Spyware, Malware, Infection, Internet, Information Assurance

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SINGLE SIGN-ON SOLUTION FOR MONTEREY SECURITY ARCHITECTURE (MYSEA) SERVICES

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The Monterey Security Architecture (MYSEA) is a trusted distributed environment enforcing multilevel security policies. To provide a scaleable architecture, a federation of MYSEA servers handles service requests. However, the introduction of multiple servers creates security and usability problems associated with multiple user logins. A single sign-on solution for the MYSEA server federation is needed. After the user authenticates once to a single MYSEA server, the user's credentials are used to sign-on to the other MYSEA servers.

The goal of this thesis is to create a high-level design and specification of a single sign-on framework for MYSEA. This entails a review and comparison of existing single sign-on architectures and solutions, a study of the current MYSEA design, the development of a new architecture for single sign-on, an analysis of single sign-on threats within a MYSEA context, a derivation of single sign-on objectives in MYSEA, leading up to the security requirements for single sign-on in MYSEA. Security and functionality are the main driving factors in the design. Others factors include performance, reliability and the feasibility of integration into the existing MYSEA Multilevel Security (MLS) network. These results will serve as a basis for a detailed design and future development of sign-on in MYSEA.

KEYWORDS: Information Assurance, Single Sign-On, Distributed Authentication, Monterey Security Architecture, Multilevel Security, Federation, Common Criteria

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COMPUTER SCIENCE

AUTOMATING CASE REPORTS FOR THE ANALYSIS OF DIGITAL EVIDENCE

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The reporting process during computer analysis is critical in the practice of digital forensics. Case reports are used to review the process and results of an investigation and serve multiple purposes. The investigator may refer to these reports to monitor the progress of his analysis throughout the investigation. When acting as an expert witness, the investigator will refer to organized documentation to recall past analysis. A lot of time can elapse between the analysis and the actual testimony. Specific reports may also be used in court as visual aids. Not all cases make it to court, but corporate managers will still likely want to review a case report. Since digital forensics is a relatively new field and can have a high learning curve, reports may be used as a mechanism for sharing knowledge of digital forensic practices.

Existing open source forensics tools are an inexpensive alternative to commercial products, but lack the functionality to generate case reports. Open source tools are more likely to be accepted by the professional forensics community with this added capability. This thesis adds case report features to the Sleuth Kit and Autopsy Forensic Browser suite of tools, the premiere open-source forensics analysis software currently available.

KEYWORDS: Computer Forensics, Digital Forensics, Digital Evidence, Case Reports, Autopsy Forensic Browser

SIMULATION AND EVALUATION OF ROUTING PROTOCOLS FOR MOBILE AD HOC NETWORKS (MANETS)

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Mobile Ad hoc networks (MANETs) are of much interest to both the research community and the military because of the potential to establish a communication network in any situation that involves emergencies. Examples are search-and-rescue operations, military deployment in hostile environment and several types of police operations.

One critical open issue is how to route messages considering the characteristics of these networks. The nodes act as routers in an environment without a fixed infrastructure, the nodes are mobile, the wireless medium has its own limitations compared to wired networks and existing routing protocols cannot be employed without modifications.

Over the last few years, a number of routing protocols have been proposed and enhanced to solve routing in MANETs. It is not clear how those different protocols perform under different environments. One protocol may be the best in one network configuration but the worst in another. This thesis describes a study of those protocols that are best from a Department of Defense (DoD) perspective. These wireless mobile networks are simulated under different mobility and traffic scenarios to evaluate their performance. Results show which protocols performed better under several relevant scenarios and expose a number of design flaws.

KEYWORDS: Mobile Ad Hoc Wireless Networks, Routing Protocols, Network Simulator, NS2, Mobility Models

COMPUTER SCIENCE

FORWARD OBSERVER PERSONAL COMPUTER SIMULATOR 2
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Due to declining budgets and decreases in ammunition allowances, the opportunity to conduct live fire artillery training has been greatly reduced. Available simulation trainers are either outdated, require specialized contractor support or are not deployable. Forward Observer Personal Computer Simulator (FOPCSim) was developed at no cost, is freely available, takes advantages of modern 3D graphics, eliminates costly contractor support and will run on laptops in support of deploying units. The simulator provides users with real-time performance feedback based on the Marine Corps Training and Readiness standards and was designed according to a cognitive task analysis of the call for fire procedures. To evaluate how well FOPCSim trains the call for fire procedures, an experiment is conducted at The Basic School in Quantico, Virginia. FOPCSim is used in place of the current simulation: Training Set, Fire Observation (TSFO), to evaluate its training effectiveness. The results of the experiment show that those students who used FOPCSim scored better on the Supporting Arms Exam than those who used the TSFO for the same amount of time. By eliminating the overhead associated with most simulators, FOPCSim allows users to perform the call for fire procedures with a high degree of repetitiveness, which is needed to train this type of task.

KEYWORDS: Virtual Environments, Virtual Training, Open Source

AUTHENTICATION SCENARIO FOR CYBERCIEGE
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Frequent media reports of the loss or compromise of data stored on computer systems indicate that attempts to educate users on proper computer security policies and procedures seem to be ineffective. In an effort to provide a means of education that will more fully engage users, the CyberCIEGE game was created. It is hoped that by playing CyberCIEGE users will absorb computer security concepts better than they have through more traditional forms of instruction, because many find games to be a compelling experience.

Many users do not understand why good passwords and password management are important for information systems. This effort develops a scenario for CyberCIEGE to teach players about issues involved when developing a password policy for a computer system. Limited testing shows the scenario accomplishes this goal. CyberCIEGE uses a Scenario Definition Language to provide developers and educators the ability to create scenarios that focus on particular concepts. To streamline scenario development, a Scenario Definition Tool is created. As a part of scenario development, this work also involves beta testing of the Scenario Definition Tool, a program that aids scenario developers in the creation of scenarios for the game. This testing results in several improvements to the tool.

KEYWORDS: Information Assurance, CyberCIEGE, Scenario Definition File, Training, Password, Authentication

COMPUTER SCIENCE

OBJECT TRACKING USING WIRELESS SENSOR NETWORKS

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Wireless sensor network (WSN) is a promising new technology. It could be a way to achieve ubiquitous computing and embedded Internet. WSNs are an efficient solution for applications that involve deep monitoring of a deployment environment. The objective of this thesis is to explore the use of WSNs for object tracking and motion estimation. It introduces the WSN technology, their theoretical characteristics, system constraints, WSN architectures, deployment topologies and standards. The object-tracking system introduced in this thesis demonstrates a real-world application that uses a WSN to track objects and communicate their information. It is an event-driven application implemented in Java, built on top of the Crossbow MSP 410 wireless sensor system. The algorithm process the data returned from the WSN detection signals and tracks the object's motion. Deployment scenarios are proposed that demonstrate suitable node topologies for the system. The evaluation of the object–tracking system is performed by conducting a number of indoor and outdoor experiments.

KEYWORDS: Wireless Sensor Network, Motion Detection, Object's Tracking, Node, Mote, Crossbow, MSP 410, Network Architecture, Nodes Topology, Active Message

USING OPEN SOURCE SOFTWARE IN VISUAL SIMULATION DEVELOPMENT

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The convergence between personal computer-based games and virtual environments technologies dramatically reduced development costs and potentially increased the use of the technology in training activities. Using open source/free software tools in the process can expand these possibilities, resulting in even greater cost reduction and allowing the flexibility needed in a training environment.

This thesis presents a configuration and architecture to be used when developing training visual simulations using both personal computers and open source tools.

Aspects of the requirements needed in a visual simulation development, processes to develop an application and issues related to the use, licensing and selection of open source/free software are analyzed to identify their limitations and possibilities.

This architecture is tested by developing a small visual simulation. The tools and engine used are presented to enable any future project applying open source software to follow similar procedures.

KEYWORDS: Visual Simulation, Open Source Software, Game Development, Virtual Environment Training, 3D Visual Simulation, Game Engine

COMPUTER SCIENCE

FEASIBILITY STUDY OF VOICE OVER INTERNET PROTOCOL (VOIP) INTEGRATION INTO THE MONTEREY SECURITY ARCHITECTURE (MYSEA) ENVIRONMENT

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Voice over Internet Protocol (VoIP) is becoming popular due to its low cost and the management advantages it offers over traditional PSTN phone systems. VoIP is widely implemented with H.323 and Session Initiation Protocol (SIP) standards. However, both protocols are poorly designed for networks with common security solutions such as firewalls and Network Address Translation (NAT).

This project is a feasibility study of SIP-based VoIP integration into the Monterey Security Architecture (MYSEA), a multilevel secure environment that uses NAT as a security mechanism. A gathering of comparative studies on VoIP protocols is performed to guide the selection of SIP as the test protocol. A set of experiments is devised and conducted using SIP-based soft phones for this study. The insights gained from the experiments provide useful insights to the MYSEA project concerning VoIP security.

KEYWORDS: Voice over Internet Protocol, H.323, Session Initiation Protocol, Network Address Translation, Monterey Security Architecture

A DESIGN FOR SENSING THE BOOT TYPE OF A TRUSTED PLATFORM MODULE ENABLED COMPUTER

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Modern network technologies were not designed for high assurance applications. As the Department of Defense (DoD) moves towards implementing the Global Information Grid (GIG), hardened networks architectures will be required. The MYSEA is one such architecture.

This work addresses the issue of object reuse as it pertains to volatile memory spaces in an untrusted MYSEA client. When a MYSEA client changes confidiality levels, it is possible that classified material remains in volatile system memory. If the system is not power cycled before the next the login, an attacker could retrieve sensitive information from the previous session. This thesis presents a conceptual design to protect against such an attack.

The proposed design uses a secure coprocessor to sense the reboot type of the host platform. In addition, a count is kept of the number of hard reboots the host platform has undergone. Using services provided by the secure coprocessor, the host platform would trustfully attest to a remote entity that it has undergone a hard reboot. This addresses the MYSEA object reuse problem. The design is tested using the CPU simulator software SimpleScalar. SimpleScalar allows for the flexible development of new CPU features that can be tested using a full suite of CPU simulators.

KEYWORDS: Information Assurance, Monterey Security Architecture, Object Reuse, Trusted Platform Module

MASTER OF SCIENCE
IN
DEFENSE ANALYSIS

SUCCESS IN CIVIL MILITARY OPERATIONS
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The purpose of this thesis is to answer the question of what determines the success of Civil Military Operations (CMO). With the United States military involved in Iraq, the largest CMO mission since World War II, answering this question becomes even more important. In this thesis, success is not confined to tactical, operational or strategic CMO success.

To determine what causes success or failure in CMO, this thesis conducts three different case study analyses of Iraq based on the three predominant ethno-religious regions of the country: Kurdish North, Sunni Center and Shi'a South. In order to analyze, compare and contrast these three separate cases, this thesis uses three independent variables: integration of CMO in all phases of the operations, balance of CMO between the combat or civilian operations and attitude of the Host Nation (HN) or occupied area. These variables set the conditions necessary for CMO success.

In conclusion, this thesis provides essential principles for CMO planning and identifies requirements in doctrine, training, organization and structure of CMO forces for future operations.

KEYWORDS: Civil Military Operations, Civil Affairs, Stabilization and Reconstruction, Special Operations, Peacekeeping, Nation Building

FASTMOVER FOREIGN INTERNAL DEFENSE (FID)
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This thesis addresses the issue of the addition of fixed-wing attack roles to the repertoire of skills taught by the aviation foreign internal (FID) defense community. FID is the mechanism by which the U.S. government instructs foreign nations in skill sets America considers important that target nations possess. The U.S.' only aviation FID unit (6 SOS) currently only offers helicopter and transport related skills sets. This study probes whether FID and aviation FID "make sense" as a tactic, using national documents and leading academic perspectives as a benchmark. Concluding that they do, it goes on to consider the utility of attack missions as a possible expansion of tactics. Ultimately, this thesis suggests that inclusion of fixed-wing attack aviation missions into the FID community is of particular utility in a post 9/11 world. The results also caution that the unique attributes of this mission require a special mindset and equipment that may not be congruous with traditional Air Force thinking/values, and that the path to implementation will require extreme diligence, patience and care to prosecute.

KEYWORDS: FID, Foreign Internal Defense, 6th Special Operations Squadron, Unconventional Airpower, Combat Aviation Advisor, Advisory Operations, CAS, Close Air Support

THE RACE AGAINST NUCLEAR TERROR
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This thesis examines the applicability of traditional Cold War strategies, such as deterrence, pre-emption, prevention, and coercive diplomacy, in denying extremists groups and associated networks the means to buy, steal or make nuclear and radiological weapons. As a principal adversary, the Soviet Union has been replaced by terror networks applying asymmetric warfare to achieve politically charged or ideologically driven objectives. A scenario whereby non-state actors would acquire a nuclear capability not only threatens the security of the United States, but would destabilize the Westphalian notion of primacy within the international system. Despite U.S. expenditures of over $86 million to help nearly 30 countries worldwide in preventing the smuggling of weapons-useable radiological materials, over 20 known cases were reported between 1992 and 2001. Previous theoretical approaches concentrated on a singularly defined target set: The Rogue State. Today's challenges are characterized by more defused, decentralized networks, to include transnational actors with the potential to proliferate and supply terrorists with a nuclear weapon or weapons-grade radiological material. Case studies considered in this thesis include the efforts by Aum Shinrikyo and al Qaeda to acquire nuclear and radiological weapons. This thesis proposes a multi-dimensional approach in support of mixed-strategies for winning the race against nuclear terror.

KEYWORDS: Nuclear Terror, Terrorism, Weapons of Mass Destruction, Social Movement Theory, Rational Choice Theory, Coercive Diplomacy, Preemption, Prevention, Deterrence, Asymmetric Warfare, Proliferation

OUTSOURCING SMALL WARS: EXPANDING THE ROLE OF PRIVATE MILITARY COMPANIES IN U.S. MILITARY OPERATIONS
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This thesis argues that, under current domestic and international laws, and current military regulations and doctrine, the U.S. Army could, with only a few uniformed personnel, employ a force consisting of predominately private military companies (PMCs) to fight a non-vital interest U.S. small war. This work identifies a historical U.S. willingness to outsource operations that are traditionally conducted by its uniformed military, categorizes outsourcing as surrogate warfare and thereby able to be managed by U.S. Army Special Forces, addresses some of the risks involved with outsourcing and analyzes the legal environment in which PMCs operate in today's environment. Recommendations provided include an illustration of how a Special Forces-led private military force should be organized, paying particular attention to the key components of the contract.

KEYWORDS: Counterinsurgency, Mercenary, Military Outsourcing, Private Military Company, PMC, Private Military Force, PMF, Small War, United States Army Special Forces, USSF, Surrogate Warfare, Weinberger Doctrine, United States Vital National Interests, Unconventional Warfare, UW

DEFENSE ANALYSIS

**REDEFINING E-3 CORE COMPETENCIES FOR DOMINANT BATTLESPACE KNOWLEDGE
IN FUTURE COMBAT OPERATIONS**
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This thesis explores how E-3 Air Battle Managers train for and perform their duties on board the Airborne Warning and Control System. The study focuses on how E-3 training is driven by the maintenance of a set of battle management core competencies rooted in the basics of aircraft tactical fluid control, force accountability and aerial refueling. The advent of a revolution in Information Management technology in the form of the 40/45 weapons system upgrade for the E-3 will drive the Air Force to rethink how training is accomplished with new capabilities and emerging missions in the battlespace. The current approach to block will not allow the Air Force to exploit the capabilities of the 40/45 airframe. Lessons from emerging areas, such as knowledge management and sensemaking, need to be assimilated into the way the Air Force trains E-3 Air Battle Managers to ensure future combat capability of aircrews in the increasingly technical and complex battlespace of future military operations. Existing core competencies need to be considered individual skill sets, and knowledge management and sensemaking introduced to better prepare battle managers to effectively and efficiently interpret inputs in the battlespace and place information where it is needed.

KEYWORDS: Knowledge Management, Sensemaking, AWACS, E-3, 40/45, Command and Control

HOW TO TRAIN AN ARMY OF INTELLIGENCE ANALYSTS
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This thesis analyzes facets of U.S. involvement in El Salvador, Colombia, Afghanistan and Iraq to demonstrate the value of using joint military training between host nation and U.S. military personnel as a vehicle to establish intelligence-sharing programs. Military-to-military relations already facilitate the distribution of logistical assistance, the exchange of technical expertise and the teaching of advanced military capabilities. However, military-to-military relations are more than just a means to provide financial and technological aid. Within this thesis, military relations are presented as a way to develop the trust necessary to operate in areas of current and future U.S. national interest, at a time when increased bilateral cooperation and intelligence sharing between the United States and coalition governments is desperately needed. Guidelines extrapolated from an analysis of political, military, cultural and intelligence sharing characteristics in each one of these countries are presented to help the U.S. and host nation personnel develop better intelligence capabilities through the training of host nation military forces; in effect, to locally train an army of intelligence analysts. Based on current American intelligence shortfalls and elusive transnational enemies, the use of military-to-military relations is proposed as a way to enhance U.S. intelligence capabilities and empower coalition partners against mutual threats.

KEYWORDS: El Salvador, Colombia, Afghanistan, Iraq, Joint Military Training, Intelligence Sharing, Military-to-Military Relations, Trust, Cooperation, Intelligence Capabilities, Host Nation, Intelligence, Analysis

ECONOMIC AND GEOPOLITICAL INTEGRATION BETWEEN MOROCCO AND ALGERIA

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Morocco and Algeria face a series of urgent problems that can only be properly addressed through higher levels of economic integration and political coordination. Greater integration will achieve two main goals. First, it will help both economies by boosting trade between the two countries and by preventing "political" barriers from undermining economic exchange. Second, higher levels of political coordination will allow both countries to align their geopolitical interests in the region and avoid antagonistic objectives. The success of such a project depends on the political will of the leadership to go beyond their past disagreements, on support from civil society in both countries and the type of institutional framework that is to be adopted. Most important, the success and level of integration will depend on the countries' ability to pragmatically address the most pressing problems each country faces and to do so in a way that is consistent with European Union (EU) and U.S. interests in the region.

KEYWORDS: Economic Integration, Geopolitical Coordination, Harmonization, Negotiation, Challenges, Obstacles, Benefits, Trade Opportunities, Economic Blocs, Region, Morocco, Algeria

SUICIDE TERRORISM: HOW PSYCHOLOGICAL OPERATIONS CAN MAKE A DIFFERENCE

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Military Psychological Operations (PSYOP) is based on a Cold War construct that has not been significantly overhauled since the end of that era. Today's most pressing challenge, the Global War on Terrorism (GWOT), requires a different solution set. The *Quadrennial Defense Review*, the *Information Operations Roadmap*, the *National Strategy for Combating Terrorism* and the *Report of the 9/11 Commission* all recognize this fact. How the military PSYOP community can best adjust to this new environment and effectively address one of its major threats, that of suicide terrorism, is the subject of this paper.

Examining what can, and arguably should, be done to counter the threat of suicide terrorism will also help the U.S. identify ways in which PSYOP could be better configured and employed in this new era. The first chapter of this thesis examines the evolution of suicide terrorism in some detail, but quickly focuses on what have emerged as the consensus opinions as to the motivations and vulnerabilities of this tactic. Chapter Two looks at the identified motivations and vulnerabilities from a PSYOP perspective and tries to apply logical PSYOP measures against them. In Chapter Three, the assets and organizational structure of the PSYOP community are reviewed and methods to best apply the current structure to meet the threat are suggested. Chapter Four looks for a way ahead and focuses on how and why making three critical changes to military Psychological Operations could improve the organization's ability to accomplish its mission; not only in terms of seeking to mitigate suicide attacks, but also with respect a whole host of new and expanded missions the PSYOP community will increasingly be called upon to address in the contemporary operating environment.

KEYWORDS: Suicide Terrorism, Terrorism, PSYOP, Psychological Operations, Deterrence Theory, Terrorist Motivations

PRINCES, PRIESTS, AND PEOPLE: IS SAUDI ARABIA THE NEXT IRAN?
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Renewed violent attacks against the monarchy in Saudi Arabia, combined with growing concern over royal corruption has led some analysts to predict that Saudi Arabia is likely to be "the next Iran" - that Islamist revolutionaries will come to power in Riyadh. This theory is tested through the lens of network analysis in order to measure the degree of state-society integration in Pahlavi Iran and Saudi Arabia. The analysis demonstrates that the Saudi state is far more integrated in society through social networks than the Pahlavi state; and the radical opposition in Saudi is far less entrenched in society than the Khomeini-led opposition in Iran, a movement that was able to activate significant informal urban networks to mobilize the population. While both are rentier states, Saudi networks in society have effectively overcome the structural state weakness and potential instability that distributive political economies often engender. The Shah had no equivalent system of networks linking regime to society, and thus was more vulnerable to revolution.

Thus, while Saudi Arabia has significant internal problems, it is highly unlikely that those problems will be manifested as a social revolution. Persistent demands for reform and periodic bouts of violence are more likely outcomes.

KEYWORDS: Saudi Arabia, Iran, Al Saud, Pahlavi, Khomeini, al Qaeda, Usama bin Laden, Informal Urban Networks, Legitimacy, State-Society Integration

APPLYING COUNTERINSURGENCY THEORY TO AIR BASE DEFENSE:
A NEW DOCTRINAL FRAMEWORK
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U.S. air bases in Iraq have been attacked over 1,000 times just in the first two years of conflict. This prompted the U.S. Air Force Deputy Chief of Staff for Air and Space Operations to declare in October 2004 that air base defense was one of the five critical problems without a solution currently facing the U.S. Air Force. However, a solution exists, though not in current air base defense doctrine, where the threat to air bases is presented as a conventional force or saboteur. Instead, the history of air base attacks reveals a different but consistent enemy over the last 50 years: the insurgent. Unlike conventional forces, which seek decisive military victory and the destruction of the adversary's military resources, the insurgent seeks primarily and ultimately a political victory. To do this, among other efforts, the insurgent must wage an "information war" in order to expand the growth and power of the insurgent organization, often through acts of symbolic violence against targets of strategic value. As such, the air base is a leading target of choice for insurgents.

Air bases are key operational and strategic terrain to the United States military - arguably the most critical terrain in the current American way of war. With each air base attack, no matter which specific tactic used, the insurgent attempts to strengthen their hold over their own center of gravity - the local population - while attacking the U.S. center of gravity - the political will of the American public. Only a base defense doctrine that targets the insurgents' center of gravity in the physical, informational and moral spectrum will succeed at disrupting insurgent operations and protect the air base, the local population and the U.S. center of gravity. Counterinsurgency provides a foundation for this proposed doctrine.

KEYWORDS: Air Base Defense, Insurgency, Counterinsurgency, Base Defense, Security Forces, Vietnam, Iraq, Da Nang, Tuy Hoa, Basra, Balad, Task Force 1041

MASTER OF SCIENCE
IN
ELECTRICAL ENGINEERING

**DESIGN AND ANALYSIS OF A MULTICOLOR QUANTUM WELL
INFRARED PHOTODETECTOR**
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Electrical Engineer-September 2005
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Sherif N. Michael, Department of Electrical and Computer Engineering

Recent military applications demand photodetectors with high sensitivity, selectivity, and multispectral capability for target detection and identification. These characteristics have been found in quantum well infrared photodetectors (QWIP). A QWIP photodetector capable of detecting simultaneously infrared emissions within near infrared (NIR), mid wavelength infrared (MWIR) and long wavelength infrared (LWIR) was studied, modeled, designed, and characterized. Using the envelope function approximation, the mathematical model of quantum phenomena in semiconductor heterostructures was derived. A computational tool was developed to solve self-consistently the Schodinger-Poisson equation using the shooting method, allowing the theoretical evaluation of the absorption coefficient. A three-color (NIR, MWIR and LWIR) GaAs-based QWIP sample and a two-color (NIR and MWIR) InP-based QWIP sample were designed, both comprising stacks of uncoupled wells for each band detection. The 67 layers of the GaAs sample was grown using molecular beam. Intersubband absorption in the sample was measured for the MWIR and LWIR using Fourier transform spectroscopy and the measured peak positions, found at $5.3 \mu m$, $8.7 \mu m$, and $13.8 \mu m$ are within 0.3 of theoretical values, indicating that the model accurately predicts absorption wavelengths. A two-dimensional ordered grating pattern was selected and optimized for both MWIR and LWIR desired peaks. Photodetector device configurations were designed to permit to measurement of the NIR band through photocurrent spectroscopy and performance analysis. Fabrication and characterization of prototypes are a matter for future work.

KEYWORDS: Quantum Well, QWIP, Three-Color Detection, Infrared Detection, Self-Consistent Shrodinger-Poisson Solution, Absorption, FTIR

HYSTERESIS CONTROL OF PARALLEL-CONNECTED HYBRID INVERTERS
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Xiaoping Yun, Department of Electrical and Computer Engineering

Integrated power systems will be used on future naval combatants, allowing unprecedented control of shipboard power to propel, sense the battle-space, and engage the enemy. One crucial technology is robust power conversion modules like the hybrid DC to AC inverter. This thesis explores the hybrid inverter scheme consisting of a six-step voltage-source inverter and a hysteresis controlled current-source inverter. The controller is redesigned to be independent of the hysteresis controller, which is fed a reference signal extracted from total output current. The signal is filtered and modified by the closed-loop system so the total output current approaches a perfect sine wave limited only by bandwidth. The modified closed-loop controller is compared to a previous NPS effort and found to improve current total harmonic distortion

from 3.2% to 1.8%. This thesis proves that existing power electronic technology can be used to produce high-fidelity waveforms for high-power Naval Propulsion Drives (50-100 MW).

KEYWORDS: Active Filter, Current-Source Inverter, Hybrid Inverter, Hysteresis Control, Parallel Inverters, Six-Step Control, Voltage-Source Inverter, DC-AC Inverter

GENERALIZED IMPEDANCE CONVERTER (GIC) FILTER UTILIZING COMPOSITE AMPLIFIER

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Second Reader: Douglas Fouts, Department of Electrical and Computer Engineering

In this research, a continuous analog generalized impedance converter (GIC) 4th order band pass filter is investigated in detail. Various classroom software aids, such as MATLAB, P-SPICE and MAPLE, are utilized to simulate various circuit parameter changes in ideal and non-ideal GIC filter, such as network sensitivity, effects of resistor value, capacitor value and reduction of gain bandwidth product (GBWP), on the center frequency and Q factor. All simulated results are used to evaluate the actual circuit implementation prior to future GIC filter chip fabrication.

A composite operational amplifier utilizing the BiCMOS standard operational amplifier that was designed and introduced in a previous thesis is presented and its improved performance is investigated. The composite amplifier (C20A2) is designed using Silvaco EXPERT and simulated with Silvaco SmartSpice. The results show the gain bandwidth product (GBWP), common mode rejection ratio (CMRR) and open loop gain are considerably improved. This sets the basic foundation for future students to incorporate the newly designed composite operational amplifier into the GIC filter to further enhance filter performance.

KEYWORDS: Generalized Impedance Converter, GIC, Active Filters, Composite Operational Amplifiers, BiCMOS Amplifiers, VLSI, Computer Simulations

A NOVEL PHOTOVOLTAIC POWER CONVERTER FOR MILITARY AND SPACE APPLICATIONS

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Second Reader: Robert W. Ashton, Department of Electrical and Computer Engineering

The purpose of this thesis is to consider photovoltaic power converter (PVPC) technology, developed by Atira Technologies, and its prospects for military and space applications. This research validates the hypothesis that PVPC technology enables a solar power system to produce usable power during low- and no-light conditions, which standard solar power systems fail to provide. Solar cell panels are exposed to sunlight at different angles and with variable intensity, therefore the resulting output power varies depending on the illumination angle as well as the light intensity of each panel. Atira Technologies devised a novel buck-boost converter that is specifically designed to track the maximum power point of each solar panel. This would provide a significant increase in the overall available power by utilizing a switching topology in a subdued lighting condition. Although a small amount of power is generated, given enough time, a battery will reach its full charge, compared to no additional charging if the battery is using a panel without the circuit. In addition, this research also shows the vital sustaining information to substantiate PVPC's claim of usefulness and effectiveness to allow for longer time on station both in the field and in space so it can extend its missions.

KEYWORDS: Solar Cells, Photovoltaic Power Converter, I-V Curve, NPSAT1, Back-Up Power

ELECTRICAL ENGINEERING

PERFORMANCE ANALYSIS OF IEEE 802.11G SIGNALS UNDER DIFFERENT OPERATIONAL ENVIRONMENTS

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Second Reader: David C. Jenn, Department of Electrical and Computer Engineering

A modern military environment requires flexible, capable and robust communications systems. Wireless communications infrastructures can provide all these services, which are absolutely necessary to soldiers on the battlefield or to mission planners. The IEEE 802.11g wireless local area network (LAN) seems to fit the military's needs since it can provide data rates up to 54 Mbps and it is backward compatible with the earlier 802.11b specification.

The purpose of this thesis is to implement, analyze and evaluate the performance of an outdoor point-to-point 802.11g WLAN under different operational environments. Implementation is achieved using two low-cost commercially available wireless bridges and directional external antennas from a well-known manufacturer, Cisco. As part of the analysis, the effective throughput of this standard, the packet error rate and the received signal strength, are measured in each of the following three environments: suburban area, medium density vegetation and coastal. The signal path loss is then calculated from the recorded results and is compared to theoretical results from common outdoor propagation models. A new path loss exponent, n, is also estimated for each case. Based on this exponent, the free space path loss model is properly modified in order to fit the measured path loss results.

KEYWORDS: IEEE 802.11g, Wireless LAN, Data Throughput, Path Loss Exponent

IMPROVED GEO-SPATIAL RESOLUTION USING A MODIFIED APPROACH TO THE COMPLEX AMBIGUITY FUNCTION (CAF)

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The purpose of this thesis is to implement the Complex Ambiguity Function (CAF)-Map method of geolocation in MATLAB. This method is a modification to the traditional Cross Ambiguity Function (CAF)-based Time Difference of Arrival (TDOA), Frequency Difference of Arrival (FDOA) geolocation, where TDOA and FDOA are determined by locating the peak in the CAF plane and then the peak's information is fed to a Least Squares like geolocation tool to determine the emitter's geolocation. This method omits the step in which the geolocation is determined with the "post processed" CAF peak information and instead maps the CAF surface directly to the earth's surface.

In this thesis, the traditional CAF-based geolocation is explained and the limitations are discussed. The development of the CAF-Map method is explained and the algorithm is presented. This thesis explores the use of the CAF-Map method as a geolocation alternative to the traditional TDOA, FDOA methods and demonstrates its ability to geolocate co-channel emitters.

KEYWORDS: Cross Ambiguity Function, CAF, Geolocation, Time Difference of Arrival, TDOA, Frequency Difference of Arrival, FDOA

ELECTRICAL ENGINEERING

**CHANNEL ESTIMATION TECHNIQUES FOR SINGLE AND MULTIPLE TRANSMIT
ANTENNA ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM) SYSTEMS**

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Orthogonal frequency division multiplexing (OFDM) is an efficient multi-carrier modulation technique that can be combined with transmitter and receiver diversity communication systems. Maximal ratio combining (MRC) and space-time block coding (STBC) can be used in conjunction with receiver and transmitter diversity in order to increase the communication system's performance. For these systems, channel estimation and tracking must be performed since the receiver requires channel state information for decoding. In this thesis, block-type and comb-type channel estimation algorithms for OFDM systems over multipath fading channels are studied and simulated. Performance results using simulated frequency-selective channels are presented.

KEYWORDS: Orthogonal Frequency Division Multiplexing, OFDM, Maximal Ratio Combining, MRC, Space Time Block Coding, STBC, Block-Type Channel Estimation, Comb-Type Channel Estimation, Least-Square, LS, Basic Channel Estimation, Simplified Channel Estimation

**MODELING, SIMULATION AND PERFORMANCE ANALYSIS OF
MUTIPLE-INPUT MUTIPLE-OUPUT (MIMO) SYSTEMS WITH MULTICARRIER
TIME-DELAY DIVERSITY MODULATION**

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Second Reader: Tri T. Ha, Department of Electrical and Computer Engineering

This thesis investigates the fundamentals of multiple-input single-output (MISO) and multiple-input multiple-output (MIMO) radio communication systems with space-time codes. A MISO system and MIMO systems are designed using the multicarrier delay diversity modulation (MDDM). The MDDM is incorporated with orthogonal frequency division multiplexing (OFDM). The design is implemented with binary phase shift keying (BPSK). MATLAB is used to simulate the design, which is tested in both an additive white Gaussian noise (AWGN) channel and in a slow fading, frequency nonselective, multipath channel with AWGN. The receiver design is incorporated with the maximal ratio combiner (MRC) receiving technique with perfect knowledge of channel state information (CSI). The theoretical performance is derived for both channels and is compared with the simulated results.

KEYWORDS: Multiple-Input Single-Output, MISO, Multiple-Input Multiple-Output, MIMO, Orthogonal Frequency Division Multiplexing, OFDM, Binary Phase Shift Keying, Rayleigh Fading Channel, Maximal Ratio Combining, MRC, Spatial Diversity

**PERFORMANCE ANALYSIS OF VARIABLE CODE RATE SIGNALS TRANSMITTED OVER
FREQUENCY-NONSELECTIVE, SLOWLY FADING CHANNELS IN A
PULSE-INTERFERENCE ENVIRONMENT**

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Wireless systems, including wireless local area networks (WLAN) and cellular networks, are increasingly being used for both commercial and military applications. For military applications, it is important to

analyze the effect of interference on wireless communications systems. The objective of this research is to investigate the performance of variable code rate signals transmitted over frequency-nonselective, slowly fading channels in a worst case, pulse-noise interference environment. Both binary phase-shift keying (BPSK) and noncoherently detected binary frequency-shift keying (NCBFSK) are considered. System performance with both Viterbi hard decision decoding (HDD) and soft decision decoding (SDD) is analyzed for additive white Gaussian noise (AWGN) alone and for AWGN plus pulse-noise interference for various receiver types and conditions of channel fading. The effect of varying the code rate, both for HDD and SDD, is examined. The amplitude of the signal power a_c^2 is modeled as a random variable, and the channel is modeled as either Rayleigh fading or Ricean fading, depending on the modulation under consideration.

KEYWORDS: WLAN, BPSK, NCBFSK, Hard Decision Decoding, Soft Decision Decoding, FEC, Convolutional Code, Rayleigh Fading, Ricean Fading, Pulse-Noise Interference, Noise-Normalization

SHIPBOARD RADIO FREQUENCY AND FREE SPACE OPTICS COMMUNICATIONS SYSTEM USING AN AIRBORNE RELAY
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This thesis explores the possible gains and discusses the constraints of a communications system that uses a ship to unmanned aerial vehicle (UAV) radio frequency (RF) link paired with a UAV to satellite free space optic (FSO) link to accomplish satellite communications. Analysis shows that a data rate of two gigabits per second (Gbps) with a $1 \cdot 10^{-6}$ probability of bit error can be attained by a shipboard system with a relatively small antenna and power supply if an FSO-enabled UAV is used. An experiment demonstrates that the addition of an FSO link and additional routing does not reduce the performance of a slower data rate RF link. Findings indicate that a composite RF and FSO ship-UAV-satellite system can be used within the Transformational Communications Architecture (TCA) and with the Navy's FORCEnet to enable network-centric operations (NCO).

KEYWORDS: Free Space Optics, FSO, Airborne Communications Node, Transformational Communications Architecture, TCA, Network-Centric Operations, NCO, Network Centric Warfare, NCW

MODELING, SIMULATION AND IMPLEMENTATION OF A NON-COHERENT BINARY-FREQUENCY-SHIFT-KEYING (BFSK) RECEIVER-TRANSMITTER INTO A FIELD PROGRAMMABLE GATE ARRAY (FPGA)
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Second Reader: Frank Kragh, Department of Electrical and Computer Engineering

This thesis presents the use of a field programmable gate array (FPGA) to implement a non-coherent binary-frequency-shift-keyed receiver-transmitter (BFSK-RT) that simulates the modulation of the SINCGARS radio, the RT-1523C. An FPGA successfully, and with very few resources, implements the desired modulation and demodulation. Topics covered include FPGA history, the hardware and software utilized, a summary of the SINCGARS RT-1523C characteristics, the BFSK-RT on FPGA design procedure and the design results.

KEYWORDS: SINCGARS, RT-1523C, Field Programmable Gate Array, FPGA, Non-Coherent Receiver Design, Binary-Frequency-Shift-Keying, BFSK, Modulator Design, On-Off Keying, OOK, Digital Communications

MASTER OF SCIENCE
IN
ENGINEERING ACOUSTICS

**EFFECT OF WIND NOISE ON UNDERSEA ACOUSTIC NETWORK
PERFORMANCE AND DESIGN**
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CDR Rebecca E. Stone, USN, Department of Oceanography

For acoustic frequencies of interest in the development of undersea wireless wide-area networks, wind noise is the dominant contribution to channel noise. The large dynamic range of wind noise forces the network designer to consider wide variations in link margin and effective node-to-node range. Previous reported correlations of acoustic communication performance and wind speed lead to multiple hypotheses explaining degradation, including noise variability and wind-driven sea-surface effects such as roughness, entrained bubbles, mixing and stratification. This thesis examines operations of a 40-node wide-area acoustic network in varying noise conditions. This data set is unique in that the environment is strongly downward refracting. Based on theoretical models, wind noise is assumed to dominate all other noise sources. Considerations include dependence of link margin and range on wind speed. Although the experiment is not designed to examine the correlation between transmission range and wind speed, a weak correlation is observed in the limited data set available.

KEYWORDS: Undersea Noise, Seaweb, Undersea Acoustics, Acoustic Communications, Link Budget, METOC Impacts

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**UNDERSEA NAVIGATION OF A GLIDER UNMANNED UNDERSEA VEHICLE (UUV)
USING AN ACOUSTIC COMMUNICATIONS NETWORK**
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Arlene A. Guest, Department of Oceanography

The U.S. Navy is developing Seaweb undersea acoustic networking technology to enable distributed autonomous ocean sensors. An unmanned undersea vehicle (UUV) can operate as a mobile node among the grid in the conduct of its own mission, using the fixed nodes as navigation reference points. In addition, the network architecture supports bidirectional communications with other collaborating vehicles and with theater undersea warfare (USW) commands. The fixed grid provides a cellular communications infrastructure for command and control and data telemetry. In turn, the UUV can support the fixed grid by physically redistributing large quantities of data throughout the network or for breaching the sea surface and acting as a mobile gateway node, communicating via satellite to a command center ashore. Assimilating UUVs as network nodes significantly enhances undersea network capability, expanding the available concepts of operations. This thesis concerns the use of the fixed undersea network as a means to track the UUV and anticipates routine operations of mobile nodes in the context of fixed grids. This work is also a fundamental step toward advanced operations of fully mobile networks in the form of collaborative swarms.

KEYWORDS: Seaweb, Slocum, Glider UUV, Acoustic Communications, Tracking, Telesonar Modem, Dead Reckoning, Racom Buoy, GPS

MASTER OF SCIENCE
IN
ENGINEERING SCIENCE

ERROR ANALYSIS OF SENSOR MEASUREMENTS IN A SMALL
UNMANNED AERIAL VEHICLE (UAV)

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This thesis focuses on evaluating the measurement errors in the gimbal system of the small unmanned aerial vehicle (SUAV) autonomous aircraft developed at the Naval Postgraduate School (NPS). These measurements are used by the vision-based target-position estimation system developed at NPS. Analysis of the errors inherent in these measurements will help direct future investment in better sensors to improve the estimation system's performance.

KEYWORDS: Unmanned Aerial Vehicle, UAV, Target Tracking, Euler Angles, Camera Line of Sight, Minimum Function, FMINUNC, Position Estimation, Piccolo, NPS Autopilot

PERFORMANCE ANALYSIS FOR A VISION-BASED TARGET TRACKING SYSTEM
OF A SMALL UNMANNED AERIAL VEHICLE

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This thesis analyzes performance of the vision-based target-tracking system developed at the Naval Postgraduate School using the Monte Carlo method. Specifically, sensitivities of the target position estimation algorithm to various sensor errors are computed. Furthermore, dependence of this algorithm on the performance of the target-tracking control system is established.

KEYWORDS: Small Unmanned Aerial Vehicle, Vision-Based Target-Tracking, Monte Carlo Method, Range Estimation, Piccolo, Graceful Degradation of Performance

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MASTER OF SCIENCE
IN
HUMAN SYSTEMS INTEGRATION

**EFFECTS OF NOISE, TEMPERATURE, HUMIDITY, MOTION AND LIGHT ON THE SLEEP
PATTERNS OF THE CREW OF THE HIGH SPEED VESSEL (HSV)-2 SWIFT**
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Second Reader: Lyn R. Whitaker, Department of Operations Research

This study examines the effects of noise, temperature, humidity, motion and light on the sleep patterns of the crew of High Speed Vessel (HSV)-2 *SWIFT* during Gulf of Mexico Exercise (GOMEX) 05-1. HSV-2 *SWIFT* is chosen for this study to examine crew sleep on an unconventional hull type manned with a small crew. Noise dosimeters, temperature and humidity monitors, actiwatches and questionnaires are used to quantify the data. With the exception of light, the independent variables do not have significant effect upon participant sleep. This is likely due to the limited range of the independent variables and the small number of participants in this study. There are two findings in this study; the relationship between the demographic variable sea time and participant sleep, and the relationship between the independent variable light and participant sleep. Due to the limitations in the current study, it is recommended that further studies be conducted in more extreme operational environments. Additionally, studies such as the one discussed in this thesis should be completed on different platforms to determine the differences in environmental factors that affect sleep between hull types. This will allow results to be applied to future vessel design.

KEYWORDS: Sleep, Noise, Temperature, Humidity, Motion, Light, Actiwatch, Littoral Combat Ship, High Speed Vessel SWIFT

MASTER OF SCIENCE
IN
INFORMATION OPERATIONS

VIRTUAL MILITARY MARKETS
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This thesis explores the utility of market mechanisms for Department of Defense (DoD) command, control, communications and collaboration (C4). The need for alternatives to improve C4 systems found by the Defense Science Board, Office of Force Transformation, and Command and Control Research Program are presented. Alternative C4 internal market structures that can help achieve the principles of network-centric operations are illustrated. Using the principles of mathematical model development, the thesis then builds a testable "E-Bay" type model for applying markets in the DoD. The model is not validated or tested in the space of this thesis and should undergo experimentation. Next, this thesis walks through an intelligence use case and presents a number of testable hypotheses for model validation. Two appendices are included. The first discusses decision making in markets by taking existing decision making tools to show how the cycle of information can be improved for the decision making commander. The second appendix is a briefing that highlights the key points of the Virtual Military Market (VMM) and the intelligence use case is provided. The thesis concludes that "practiced adhocracy" and improved decision making can be achieved by the VMM and that DoD should explore this concept further.

KEYWORDS: Alternative Command, Control, Communication, Collaboration, C4, Internal Markets, Solutions, Transaction Space

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LOSING THE POPULATION; THE IMPACT OF COALITION POLICY AND TACTICS ON THE POPULATION AND THE IRAQI INSURGENCY
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Second Reader: Douglas A. Borer, Department of Defense Analysis
Third Reader: Maj Tara Leweling, USAF, Department of Information Sciences

This paper examines the initial phases of the U.S.-led occupation of Iraq and evaluates the impact of Coalition policy and tactics on the population and the Iraqi insurgency. The Coalition has faced unanticipated challenges and violence in Iraq for three primary reasons: first, an inability to provide security for the Iraqi population; second, the rapid collapse in Iraqi confidence in the Coalition; and finally, the availability of uncontested physical and information space for opposition mobilization. These three key developments occurred due to a mismatch between Coalition policies and tactics implemented in the immediate aftermath of the fall of Saddam Hussein. At the macro level of analysis, Coalition policies and tactics are evaluated using criteria established by a first-hand authority on Arab revolt: T.E. Lawrence, who fostered revolt in Mesopotamia in World War I. At a more specific level of analysis, the author examines, through the lens of social movement theory, the creation and growth of opposition in Sunni areas, as well as the immediate threat posed by the Sadr II Movement. This paper concludes that the rapid decline of popular support for the Coalition between April and August 2003 emanated from Coalition policies and tactics that did not emphasize security for the population. In turn, these security policies

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created and enabled opportunities and space in which opposition to the Coalition could mobilize with relative impunity.

KEYWORDS: Iraq, Insurgency, Social Movement Theory, T.E. Lawrence, Coalition Provisional Authority, CPA, JTF-7, Intelligence, Muqtada Al-Sadr, Abu Musab Al-Zarqawi, GEN Franks, Bremer, Jay Garner, ORHA, Iraqi Population, Confidence, Mobilization

WAR IN SHANGRI-LA: THE INFORMATION DIMENSION OF NEPAL'S MAOIST INSURGENCY AND COUNTERINSURGENCY
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This analysis examines the information dimension of the ongoing Maoist insurgency and counterinsurgency in Nepal. The paper follows two lines of research: first, it presents an analytic framework that properly conceives the challenge of counterinsurgency and calibrates government actions through the use of information systems and operations; then, it applies this framework to the contemporary crisis in Nepal in order to postulate effective counterinsurgency strategies for the Nepalese government and its supporters. The paper analyzes the environment, structure and dynamics of the insurgent and counterinsurgent systems in Nepal to determine the extent to which information is - or could be - employed in the fight. Based on the conditions identified in the research, the paper proposes information-based strategies and tactics that favorably affect conflict dynamics on behalf of the Nepalese government. Finally, the paper offers constructive and appropriate ways for the U.S. to support Nepalese information operations efforts in the counterinsurgency. This research focuses primarily on use of information in insurgency, but it also realizes that information strategies must be balanced and blended with other important dimensions of insurgent conflict. Thus, the insights gained here are intended to support further analysis of the larger set of dynamics that shape conflict in Nepal.

KEYWORDS: Nepal, Maoist, Insurgency, Counterinsurgency, Information Operations, Information Warfare

MASTER OF SCIENCE
IN
INFORMATION TECHNOLOGY MANAGEMENT

AIRBORNE TACTICAL DATA NETWORK GATEWAYS: EVALUATING THE ENHANCED POSITION LOCATION REPORTING SYSTEM'S (EPLRS) ABILITY TO INTEGRATE WITH WIRELESS MESHED NETWORKS

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Second Reader: Glenn Cook, Department of Information Sciences

This thesis assesses the feasibility, suitability, efficacy and military potential of using the Enhanced Position Location Reporting System (EPLRS) from airborne communications nodes with emergent commercial-based wireless technologies.

Such integration would offer highly mobile maneuver units with over-the-horizon (OTH) tactical data connectivity. Specifically, this work examines tactical data requirements intrinsic to military operations with current OTH tactical data solutions. It also explores current EPLRS architectures and use and compares the functional capabilities and limitations of EPLRS with those of IEEE 802.11x and 802.16 standards and prevalent developing meshed network routing protocols.

Finally, this thesis evaluates fielded and emergent technologies to see if they are suitable to build and to sustain (collectively or independently) interconnected, ubiquitous and routable tactical data networks by capitalizing on the advantages of EPLRS and by exploiting the inherent advantages of airborne assets in overcoming line-of-sight (LOS) limitations.

KEYWORDS: EPLRS, ACN, ATDNG, Wireless Networking, Mesh, OTH Data Connectivity

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PROTOTYPING A WEB-ENABLED DECISION SUPPORT SYSTEM TO IMPROVE CAPACITY MANAGEMENT OF AVIATION TRAINING

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For organizations with training pipelines, this study offers insight to help identify and minimize undesirable effects that may result from often unavoidable demand variations within a resource and time constrained environment. The highly complex Naval aviation training process is used as a case study. However, any organization with a training pipeline may find this study useful. Within a training pipeline, like any resource constrained production line, variability may cause undesirable results to occur. Variability includes any change in the number of students to train, time-to-train, instructor availability, material availability and other supporting factors. Undesirable effects may include delayed time-to-train, wasted valuable resources, reduced morale, reduced quality of training or an increase in undesirable behaviors as a result of perceived production pressures. "Wasted valuable resources" includes human capital, money, material and time. Although other sources of variability are discussed, this study primarily examines the cause and effect relationships resulting from variations in the number of students to train. Potential solutions are explored.

INFORMATION TECHNOLOGY MANAGEMENT

AN ANALYSIS OF IEEE 802.11B AND 802.16 TECHNOLOGIES AS PART OF THE TACTICAL INTERNET

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This research evaluates IEEE 802.11 and 802.16 technologies to examine whether these wireless technologies integrate into the Tactical Internet. In order to establish a baseline, the current Marine Corps' systems architecture is analyzed with specific emphasis on mobile forces at the Regimental level and below. A side-by-side comparison between existing communication assets in the Marine Corps inventory, such as the Enhanced Position Location Reporting System (EPLRS), the Single Channel Ground and Airborne Radio System (SINCGARS) and available 802.11/16 technologies, evaluates whether existing command and control requirements are met, determines the existence and extent of excess capacity and identifies potential adaptations required to implement commercial-off-the-shelf (COTS) technology into a military environment.

The method for side-by-side evaluation incorporates both COTS products and Marine Corps tactical communication devices in laboratory and field experimentation. This research captures key performance metrics such as range, power consumption, security and bandwidth, but remains focused on the needs of the warfighter by evaluating performance of the system in support of Command and Control Compact Edition (C2CE) and Command and Control Personal Computer (C2PC) applications.

SHARING INFORMATION AMONG VARIOUS ORGANIZATIONS IN RELIEF EFFORTS

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Today, information sharing is critical to almost every institution and organization. There is no more pressing need for information sharing than during an international crisis, where multi-national military-civilian (such as UN and non-governmental organizations (NGOs)) coordination is formed. Successful information technology implementation for international crises could be increased by analyzing prior relief efforts. The purpose of this thesis is to explore the role of information technology in enabling the sharing of actionable information among various organizations in relief efforts.

At all levels of relief efforts, strategies to provide adequate help to the victims of disaster will rely on the development and distribution of actionable information. It is essential that participants strengthen their capacity to gather, share, analyze and disseminate such information. When using or developing information technology in relief operations, it is necessary to be aware of the obstacles related to information sharing. Due to the uniqueness of each relief operation, dependant on the various participants and nature of the disaster, it is difficult to define the problems, symptoms and possible solutions of each situation. Specifically, this thesis attempts to establish the requirements for the development of a Disaster

Information Management System by examining both the universal problems in disaster relief operations and their possible solutions from within information technology.

KEYWORDS: Information Technology, Information Sharing, Coordination, Non-Governmental Organizations, International Organizations, Relief Operations, Distributed Database, Client/Server Architecture, Geographic Information System, GIS

PERFORMANCE COMPARISON OF RELATIONAL AND NATIVE-XML DATABASES USING THE SEMANTICS OF THE LAND COMMAND AND CONTROL INFORMATION EXCHANGE DATA MODEL (LC2IEDM)

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Efforts to improve the military decision and action cycle have centered on automating the command and control process and improving interoperability among joint and coalition forces. However, information automation by itself can lead to increased operator overload when the way this information is stored and presented is not structured and consistently filtered. The majority of messaging systems store information in a document-centric free-text format that makes it difficult for command and control systems, relational databases, software agents and web portals to intelligently search the information. Consistent structure and semantic meaning is essential when integrating these capabilities. Military-grade implementations must also provide high performance.

A widely accepted platform-independent technology standard for representing document-centric information is the Extensible Markup Language (XML). XML supports the structured representation of information in context through the use of metadata. By using an XML Schema generated from MIP's Land Command and Control Information Exchange Data Model (LC2IEDM), it is feasible to compare the syntactic strength of human-readable XML documents with the semantics of LC2IEDM as used within a relational database.

The insert, update, retrieve and delete performance of a native-XML database is compared against that of a relational database management system (RDBMS) implementing the same command and control data model (LC2IEDM). Additionally, compression and parsing performance advantages of using various binary XML compression schemes is investigated. Experimental measurements and analytic comparisons are made to determine whether the performance of a native-XML database is a disadvantage to the use of XML. Finally, because of the globally significant potential of these interoperability improvements, a number of look-ahead items to future work are proposed, including use of the Joint Consultation Command and Control Information Exchange Data Model (JC3IEDM).

KEYWORDS: Allied Data Publication 3, ADatP-3, Battlespace Generic Hub, Extensible Markup Language, Interoperability, Land Command and Control Information Exchange Data Model, LC2IEDM, Relational Database Management System, RDBMS, XML, XML Binary Compression, XML Schema, XML Schema-Based Binary Compression, XSBC, AUV Workbench

INFORMATION TECHNOLOGY MANAGEMENT

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (CRADA) WITH INDUSTRY AS A VALUE ENHANCING ASSET IN THE ACADEMIC/RESEARCH ENVIRONMENT - A CASE STUDY AT THE NAVAL POSTGRADUATE SCHOOL (NPS)

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Cooperative Research and Development Agreements (CRADAs) are used by federal laboratories to participate in collaborative efforts and partnerships with industry. Although not technically a research laboratory, the Naval Postgraduate School (NPS) is a federally funded research university that has developed an extensive sponsored program of Technology Transfer (T2) with the private sector. Cooperative research and development is often a two-way instrument, where knowledge-generated value can flow in both directions. This thesis research assesses that value, from the perspective of the federal partner, based on the NPS case as a specialized academic and research institution.

The research and analysis performed within the context of this thesis contributes to goals established in the NPS "Technology Transfer Business Plan," focusing on the measurement of outcomes and benefits resulting from CRADAs, one of the preferred and most widely used mechanisms in technology transfer within the domain of the Department of Defense (DoD) and particularly at NPS. The perspective chosen, in the direction from the non-federal entity - generally industry - towards the federal partner, has not been researched and reported in the specialized literature as extensively as in the opposite direction.

KEYWORDS: Technology Transfer, Cooperative Research and Development Agreements, CRADAs, University-Industry Partnerships

AN ANALYSIS OF AUTOMATED SOLUTIONS FOR THE CERTIFICATION AND ACCREDITATION OF NAVY MEDICINE INFORMATION ASSETS

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The purpose of this study is to determine potential improvements in Navy Medicine's current certification and accreditation (C&A) process. The study examines whether Navy Medicine's C&A policies are in alignment with the Department of Defense (DoD), Navy and federal government requirements and whether the use of automated C&A tools could significantly improve Navy Medicine's current C&A security posture.

The primary research reviews C&A policy and includes a comparative analysis of two cutting edge automated C&A tools, namely, Xacta and eMASS. Findings of the analysis reveal that the use of automated C&A tools could significantly enhance Navy Medicine's C&A process and assist Navy Medicine's information assurance personnel, who are responsible for the execution of the Navy Medicine C&A process and approval of Navy Medicine information systems. This study also provides valuable insight in verifying the evidence on how information assurance (IA) controls are addressed within the automated C&A tools regardless of the C&A process. The results of the analysis ultimately lead to the development of key recommendations that can assist Navy Medicine in selecting the appropriate automated C&A tool for its C&A process.

KEYWORDS: Certification, Accreditation, DITSCAP

INFORMATION TECHNOLOGY MANAGEMENT

WIRELESS LOCAL AREA NETWORK (WLAN) VULNERABILITY
ASSESSMENT AND SECURITY
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The proliferation of wireless computer equipment and Local Area Networks (LANs) create an increasingly common and growing threat to Marine Corps Network infrastructure and communication security (COMSEC). This threat requires a capable deterrent in order to mitigate risks associated with both official and un-official wireless LANs. The potential efficiencies gained by employing wireless technology within the Marine Corps and the Department of Defense (DoD) is quite significant. The Marine Corps must leverage this relatively inexpensive technology to conduct operations cheaper, faster and more effectively. However, these same wireless LAN capabilities have introduced new ways in which critical information infrastructure can be viewed, altered or even denied. This thesis proposes the assessment of multiple installations within DoD in order to identify vulnerabilities and ensure secure employment of wireless technologies. These assessments will enable the development of adequate measures to secure existing wireless transmissions and protect future transmissions from observation, modification or denial of service.

This thesis assesses threats posed to network infrastructure by wireless networks and evaluates WLANs that exist within the DoD to determine adequate measures to secure transmissions made by those networks. Vulnerability assessments of multiple services at different DoD installations are conducted in order to gather a wide range of input. The assessments provide an indication of how DoD installations are leveraging wireless capabilities to improve support to the operating forces. These vulnerability assessments also provide insight into the current security posture within the DoD with regard to wireless communications. The practices employed by these services are evaluated to determine the best means of standardizing wireless security procedures within the Marine Corps. In addition, a diverse assortment of wireless software and hardware tools is tested in order to ascertain the best methods for monitoring and securing wireless networks within the DoD. The evaluation of these software and hardware tools will facilitate the creation of inexpensive and easily distributed WLAN tool kits that can be employed at installations across the DoD. Finally, recommendations are provided on how to improve the WLAN vulnerability assessment capability within the Marine Corps.

KEYWORDS: Wireless Local Area Network, WLAN, WiFi, 802.11a/b/g, WLAN Security, Vulnerability Assessment

THE UNITED STATES NAVAL RESERVE COMPONENT'S ACCOUNT MANAGEMENT
CHALLENGE IN A NAVY MARINE CORPS INTRANET ENVIRONMENT
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Declining budgets and the reduction of the workforce has caused many organizations to perform additional job assignments with fewer personnel. These organizations realized that in order to survive in a competitive market, scarce resources would provide the most value if used to work on mission-essential tasks, while allowing the performance of support functions by an outside source (called outsourcing). The Department of the Navy (DoN) is one organization that has chosen to outsource many business areas, but none bigger than the outsourcing of information technology (IT) to form the Navy Marine Corps Intranet (NMCI) - the largest IT outsourcing contract to date.

While the DoN has faced many challenges since the onset of the NMCI contracting agreement, this thesis focuses on the challenges faced by the Naval Reserve with managing the Intranet's user accounts.

The research uses the principles of Business Process Redesign (BPR) and Knowledge Management (KM) to determine the current state (As-Is) and to recommend changes in the account management process. Specifically, the Knowledge-Value Added (KVA) methodology is used to determine the amount of knowledge quantitatively embedded in each sub-process for a relative comparison of the value that the sub-processes provide to the overall process.

KEYWORDS: Navy Marine Corps Intranet, NMCI, Seat Management, Outsourcing, U.S Naval Reserve Component, Naval Reserve, Account Management, Knowledge Value Added, KVA, Return On Knowledge, ROK, Business Process Redesign, BPR, Knowledge Management, Measuring Knowledge

A STUDY OF THE IEEE 802.16 MAC LAYER AND ITS UTILITY IN AUGMENTING THE AUTOMATED DIGITAL NETWORK SYSTEM (ADNS) ARCHITECTURE TO PROVIDE ADAPTABLE INTRA-STRIKE GROUP HIGH SPEED PACKET SWITCHED DATA, IMAGERY AND VOICE COMMUNICATIONS

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This research evaluates the Medium Access Control Layer (MAC) of the IEEE 802.16 Wireless standard and its utility in augmenting the IP router based Automated Digital Network System (ADNS). This research explores the need for a high throughput, high-speed network for use in a network centric wartime environment and how commercial-off-the-shelf (COTS) technologies that take advantage of the 802.16 wireless protocol can satisfy these requirements. The intent of this research is to prove that 802.16 systems can provide the ADNS with a viable alternative in order to enhance its capabilities and mitigate its limitations.

This research includes a discussion on the current configuration of the ADNS architecture and its uses in the Expeditionary Strike Group (ESG). This research also analyzes the 802.16 MAC layer and identifies and tests the unique quality attributes that make it a viable high speed, high throughput communication link for point-to-point and point-to-multipoint naval applications.

KEYWORDS: 802.16, WiMax, Wireless, Network, ADNS, COTS, MAC, Intra-Strike Group Communications, Packet Switched Data

AN ANALYSIS OF THE USE OF MEDICAL APPLICATIONS REQUIRED FOR COMPLEX HUMANITARIAN DISASTERS OR EMERGENCIES VIA HASTILY FORMED NETWORKS (HFN) IN THE FIELD

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This thesis analyzes the feasibility, efficacy and usability of medical operations working in concert with a Fly-Away-Kit (FLAK) and the forming of hastily formed networks (HFNs) in support of humanitarian-assistance and disaster-relief (HA/DR) operations. The initial focus of this research is on the requirements, situation, area of operations and mission differences between nongovernmental organizations and governmental organizations. The thesis researches and discusses the possibilities for implementing medical technology in the field and the conditions and scenarios in HA/DR that may affect its success. This process also defines the requirements for medical operations and facilitates a methodology for ensuring that those

requirements are met. This thesis investigates the suitability of currently available COTS hardware and software components for medical operations. In addition, it includes a comprehensive review of the value of electronic medical records and telemedicine technologies.

Virtually all organizations responding to the December 26, 2004, Southeast Asia tsunami did not have the benefit of large-scale medical information technology. For example, the ability to ascertain the real extent of injuries due to the tsunami was hampered by the lack of a central database. Initial media reports claimed a death toll of over 300,000 people, when the more accurate tally was just over 200,000 dead. This disparity resulted from an archaic system of tracking and accounting. Undoubtedly, humanitarian medical organizations will greatly benefit from the implementation of medical information technology capabilities. This thesis lays the groundwork for further research into medical technologies that can be deployed in the field with humanitarian medical teams in the near future.

KEYWORDS: Medical, Hastily Formed Networks, HFN, Rapid Deployable Networking, Humanitarian Disasters, NGO, Electronic Medical Record, Telemedicine

PROOF OF CONCEPT: IRAQI ENROLLMENT VIA VOICE AUTHENTICATION PROJECT
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This thesis documents the findings of the Naval Postgraduate School (NPS) research team's efforts on the initial phase of the Iraqi Enrollment via Voice Authentication Project (IEVAP). The IEVAP is an Office of the Secretary of Defense (OSD) sponsored research project commissioned to study the feasibility of speaker verification technology in support of the Global War on Terrorism security requirements. The intent of this project is to contribute toward the future employment of speech technologies in a variety of coalition military operations by developing a pilot proof-of-concept system that integrates speaker verification and automated speech recognition technology into a mobile platform to enhance warfighting capabilities.

In this first phase of the IEVAP, NPS develops, with the assistance of Nuance Communications, Inc. and the Defense Language Institute, a bilingual (English and Jordanian-Arabic) speech application that demonstrates the viability of speaker verification technology for use in operations in Iraq. Additionally, NPS conducts a test to assess the accuracy claim of Nuance's packaged speaker verification application, Nuance Caller Authentication 1.0 (for North American English). The NPS test consists of 68 speaker enrollments and 411 speaker verification attempts. Upon completion of the test, NPS conducts a single data-point analysis yielding a system accuracy of 95.87%.

KEYWORDS: Speaker Verification, Voice Authentication, Voice Verification, Voice Biometrics

802.16 ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM) RAPIDLY DEPLOYED NETWORK FOR NEAR-REAL-TIME COLLABORATION OF EXPERT SERVICES IN MARITIME SECURITY OPERATIONS
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The world's shipping lanes are an area of intense focus in the Global War on Terror. Every day millions of tons of cargo are shipped though thousands of ports. Most cargo is harmless; however, some ships carry the weapons and human operators of terrorist organizations. To prevent the spread of weapons and terror suspects on the sea lanes, the cargo, passengers and crew of these vessels must be subject to scrutiny that is orders of magnitude greater than current efforts. The ability to rapidly extend a network and provide virtual

expert services to Visit, Board, Search and Seizure (VBSS) boarding teams is crucial to protecting the United States and its allies from sea-born terror attacks and infiltration.

This thesis uses scenario based experimentation to examine the methods for implementing near-real-time collaborative work spaces in a virtual environment able to support VBSS operations anywhere in the world, limited only by network connectivity. The use of collaborative tools vastly increases the amount, type and accuracy of information that can be processed. Radiation detection or classification and biometric fusion are two of the hundreds of virtual collaborative sources that can be leveraged as a force multiplier and brings network centric warfare to the maritime security domain.

KEYWORDS: Mesh, Orthogonal Frequency Division Multiplexing, OFDM, Groove Virtual Office, Situational Awareness Multi Agent System, Internet, Nodes, Wireless, IEEE 802.16, Peer to Peer Relationships, Collaborative Environment, Common Operating Picture, Tactical Network Topology, Lawrence Livermore National Laboratory, Tactical Satellite, Ultra-Wideband, Expert Service Reach-Back

IMPLEMENTING A PATTERNLESS INTRUSION DETECTION SYSTEM: A METHODOLOGY FOR ZIPPO
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A methodology for the implementation of Zippo, a patternless intrusion detection system, is presented in this thesis. This methodology approaches the implementation in a holistic manner, to include the administrative and operational tasks necessary for ensuring proper preparation for Zippo's use. Prior to implementing and using Zippo, a basic understanding of Transmission Control Protocol/Internet Protocol (TCP/IP) and intrusion detection systems is needed and these topics are presented in broad detail. The origin of Zippo starts with the creation of Therminator, which is discussed in detail. The architecture and configuration of Zippo are based on those of Therminator and understanding the ideas of buckets and balls, thermal canyons and towers, decision trees, slidelength and windowlength and initial and boundary conditions are paramount to understanding the Zippo application. To successfully implement Zippo, other network factors must be attended to, including the topology, organizational policies and the security plan. Once these factors are addressed, Zippo can be optimally configured to successfully be installed on a network. Finally, previous research conducted on Zippo yielded decision trees and thermal canyons pertaining to protocol specific threats, which are presented to familiarize the reader with Zippo's visual representation of malicious or anomalous behavior.

KEYWORDS: Network Security, Intrusion Detection, Zippo, Therminator, Patternless Intrusion Detection Systems

INFORMATION TECHNOLOGY MANAGEMENT

TACTICAL WIRELESS NETWORKING IN COALITION ENVIRONMENTS: IMPLEMENTING AN IEEE 802.20 WIRELESS END-USER NETWORK UTILIZING FAST, LOW-LATENCY ACCESS WITH SEAMLESS HANDOFF, ORTHOGONAL-FREQUENCY-DIVISION MULTIPLEXING (FLASH OFDM) TO PROVIDE A SECURE MOBILE EXTENSION TO EXISTING WAN

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This thesis focuses on the area of 802.20 wireless networking as a feasible "last mile" solution to wireless access in a tactical coalition environment and implements a series of experiments. Implementation primarily utilizes Flarion's Fast, Low-Latency Access with Seamless Handoff Orthogonal Frequency Division Multiplexing (FLASH OFDM).

Current and future military and homeland security forces conducting operations in a tactical environment require instant access to data. Wireless data requires a reliable air-link resource anchored to a viable service platform. Flarion's FLASH-OFDM wireless air-link mimics the performance of a high-speed wireline environment. Through Flarion's Radio Router base station and mobile data terminal, a Radio Access Network is created. It connects directly to a standard IP Packet Data Network, forming a wireless data network.

Utilizing this network environment, implementation of a limited objective experiment (LOE) in support of homeland security and the War on Terrorism (WOT) is documented; specifically, the testing of an IEEE 802.20 network enabling U.S. and key foreign partners to integrate mobile wireless local area network (WLAN) technologies into a surveillance and target acquisition network program.

KEYWORDS: 802.20, 802.16, OFDM, Fast Low Latency with Seamless Handoff, FLASH, Office of the Chief Technology Officer, OCTO, Military Operations in an Urban Terrain, MOUT, Mobile WAN, NLOS, Radio Router

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DEVELOPING A RELIABLE METHODOLOGY FOR ASSESSING THE COMPUTER NETWORK OPERATIONS THREAT OF IRAN

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This thesis is part of a project at the Naval Postgraduate School to assess the Computer Network Operations (CNO) threat of foreign countries. CNO consists of Computer Network Attack (CNA), Computer Network Exploitation (CNE) and Computer Network Defense (CND). Threats to the nation's critical infrastructures come from an adversary using CNA and CNE to degrade, deny or destroy access to the information systems they depend upon. Defensive capabilities are also addressed since exploitation, attack and defense are inherently related. The result of a successful cyber-attack upon these critical infrastructures has the potential to cripple a country's communications and other vital services, economic well-being and defensive capabilities.

The goal of this thesis is to develop a methodology for assessing the CNO threat of Iran. The methodology is based on open sources that can supplement classified information acquired by the intelligence community.

INFORMATION TECHNOLOGY MANAGEMENT

HIGH THROUGHPUT TACTICAL WIRELESS NETWORKING FOR SURVEILLANCE AND TARGETING IN A COALITION ENVIRONMENT: AN ANALYSIS OF THE NEXT GENERATION IEEE 802.11N EQUIPMENT AND STANDARD
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This thesis presents a technology review of the emerging IEEE 802.11n standard. A wireless local area network (WLAN) based on state-of-the-art equipment supporting the 802.11n protocol is evaluated in the Coalition Operating Area Surveillance and Targeting System (COASTS).

This thesis also provides a brief introduction to COASTS, its support for testing various networking schemes and their effectiveness in supplying information necessary to reach a decision maker's desired end-state. Also provided is a summary of the current state of the 802.11n proposed standard, the hardware and software used to evaluate the equipment and the testing methodology.

In general, the methodology is to conduct field tests with private vendors and coalition partners to evaluate the capabilities of 802.11n networks that promise large throughput benefits for WLANs. The specific goal of this research focuses on testing equipment and network configurations in an IP network.

The ultimate goal of this research is to evaluate an evolutionary improvement for our forces to transfer large amounts of data and to maintain the mobility and flexibility to deploy rapidly to areas with little or no infrastructure. With this capability, our forces may gain control of the environment, dramatically improve tactical situational awareness and attain information superiority.

MASTER OF SCIENCE
IN
MANAGEMENT

ANALYSIS OF RECRUIT ATTRITION FROM THE U.S. MARINE CORPS'
DELAYED ENTRY PROGRAM
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The Marine Corps expends much effort and money annually in recruiting qualified applicants to fill its ranks. Yet, an average of one out of every five new recruits leaves the Delayed Entry Program (DEP) even before attending boot camp. This thesis uses binary probit models to analyze four years of enlistment data obtained through the Total Force Data Warehouse (TFDW) from five of the six Marine Corps Districts (MCDs). The study first investigates whether the discharge probability of a new recruit varies by the day of the month in which the recruit signs an enlistment contract. Building on this relationship, the thesis then analyzes attrition prediction variables to differentiate recruits who exhibit a disproportionately high attrition risk from those who do not. Results show that a recruit's attrition risk does increase dramatically with the approach of the monthly deadline. Additionally, recruits who exhibit a high risk of attrition can be identified using current enlistment criteria. With the information provided by this thesis, the Marine Corps can effectively target high-risk recruits and thereby lower its DEP attrition.

KEYWORDS: Delayed Entry Program, Attrition, Goal Setting, Quality, Marine Corps, Manpower, Recruiting, Human Capital

MASTER OF SCIENCE
IN
MECHANICAL ENGINEERING

FLUID-STRUCTURE INTERACTION EFFECTS RESULTING FROM
HULL APPENDAGE COUPLING
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In previous work conducted in the modeling and simulation of ships subjected to underwater explosions, there has been some debate over the influence that hull appendages have upon the dynamic response of a multi-degree-of-freedom structural model surround by a fluid mesh. This thesis investigates the effects on the dynamic response of a structural model resulting from the inclusion of hull appendages, such as rudders, shafts and keel boards. Moreover, it examines the differences resulting from these appendages having been modeled as coupled or uncoupled structures with respect to the surrounding fluid in the finite element analysis. In this case, a Meko-like box model, based on the actual dimensions of a typical Meko-class ship, is investigated using the underwater shock modeling and simulation methodology developed at the Naval Postgraduate School's Shock and Vibration Computational Laboratory. Presented herein is a detailed study on the validity of including hull appendages, the proposed coupling scheme for these appendages and the resulting effects on the vertical and athwartship velocity response motions.

KEYWORDS: Underwater Explosion, Shock and Vibration, Modeling and Simulation, UNDEX, Shock Response, Ship Shock, Meko

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COMPUTATIONAL ANALYSIS OF FLOW IN A TRANSONIC COMPRESSOR ROTOR
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As the United States Navy prepares to field a single engine jet, the F-35C Joint Strike Fighter, it is important that the causes of the "pop-stall" occurrence be understood. This problem arises as the jet engine ingests steam just prior to being released from the catapult. In examining this problem, two Computational Fluid Dynamic (CFD) codes have been used by the Naval Postgraduate School to predict the performance of a transonic compressor rotor that is being tested with steam ingestion. Both codes, developed by the National Aeronautics and Space Administration (NASA), provide an accurate basis for experimental results and new CFD codes to be compared to. Ansys Inc., a commercial computer aided design (CAD) software company, has developed a new code that allows for modeling of two-phase flow. ICEM-CFD and CFX-5, both Anys, Inc. software that can model turbomachinery blade passages similar to that used by the NASA codes, are used in this thesis. Comparisons are made with the experimental data and the predictions made by NASA codes as part of the initial modeling of the transonic compressor rotor.

KEYWORDS: Compressor, Transonic, Steam Ingestion, Computational Fluid Dynamics, CFD, Turbo-Machinery, Pop-Stall, Rotor, Shock Waves

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MECHANICAL ENGINEERING

EXPERIMENTAL AND COMPUTATIONAL INVESTIGATION OF FLOW IN A TRANSONIC COMPRESSOR INLET

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As part of an initial baseline survey of the inlet flow-field into a transonic compressor rotor, a five-hole probe is calibrated and used to determine the Mach number and inlet pitch angle distributions. The data for Mach number are compared to data obtained with a three-hole probe. A numerical investigation of the flow in the inlet ducting to the rotor is also initiated using the commercial code CFX, which is marketed by ANSYS. Comparisons are also made between the numerical predictions and the experimental measurements. The purpose of the study is to more accurately determine the characteristics of the flow to the rotor of the compressor prior to steam-ingestion experiments to quantify effects on compressor stability.

KEYWORDS: Compressor, Transonic, Steam Ingestion, Inlet Distortion, Computational Fluid Dynamics, Multiphase Flow

THERMO-MECHANICAL RESPONSE OF MONOLITHIC AND NITI SHAPE MEMORY ALLOY FIBER REINFORCED SN-3.8AG-0.7CU SOLDER

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In electronic packaging, the reliability of solders is a critical issue, because they serve as both electrical and mechanical connections. The most common failures arise from the thermo-mechanical fatigue (TMF) of solders, due to mismatches in the coefficient of thermal expansion between the Si-chip and the printed circuit board. In order to meet the demands of miniaturization and enhanced performance in severe environments, a novel adaptive tin-silver-copper (SnAgCu) solder reinforced with NiTi shape-memory alloy (particles or fiber) has been developed.

An experimental apparatus is designed to investigate the thermo-mechanical strain-controlled fatigue life of the solder during both single and multiple thermal cycling under double-shear loading. For comparison, thermo-mechanical single shear tests are also performed in monolithic Tin-Silver-Copper solder and in solder reinforced with Cu fiber. Also, micro-structural evaluation of the solders during the fifth cycle is possible using scanning and optical microcopy together with EDS (elemental) analysis.

KEYWORDS: Thermo-mechanical Cycling, Low-Cycle Fatigue, Copper Reinforced Solder, Nickel-Titanium Reinforced Solder

IMPROVED AEROTHERMODYNAMIC MEASUREMENTS OF A T63-A-700 GAS TURBINE ENGINE

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This thesis contains an analysis of the failure of the instrumentation ring for measuring the combustor exit temperature and total pressure in the T63-A-700 gas turbine engine. An improved ring design is constructed and installed. Extensions to the exhaust stacks are installed to keep the cell temperature reasonable. A water-cooled heat exchanger is installed in place of an air-cooled heat exchanger that was not adequately cooling the oil temperature while running the engine. In the program GASTURB, a compressor map with data from the manufacturer is created and an operating line from three separate speeds is plotted.

MECHANICAL ENGINEERING

THE EFFECT OF FRICTION STIR PROCESSING ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF AF/C458 ALUMINUM LITHIUM ALLOY
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Aluminum-lithium alloys have been under development for lightweight - high strength aerospace structures, but implementation has been slowed significantly because of poor short transverse fracture toughness and brittle intergranular delamination cracking. This phenomenon makes failure assessments at stress concentrators especially difficult. The alloy AF/C458 (now designated AA 2099) has been designed to exhibit decreased mechanical anisotropy and improved fracture toughness while maintaining ductility and strength levels. This thesis examines the application of Friction Stir Processing (FSP) of AF/C458 as an approach to refine and homogenize the grain structure and enhance mechanical properties. FSP results in refined, equiaxed grains but with reduced hardness due to the heat input of the process. The effect of post-FSP heat treatment has been determined and the influence of FSP on tensile and fatigue properties has been determined.

DESIGN AND VALIDATION OF IMPROVED DYNAMIC CYLINDER PRESSURE MEASUREMENT FOR A DIESEL ENGINE
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An existing encoder system is analyzed to determine why the system failed. This encoder system is found to have slipped off the crankshaft, resulting in the need for a new encoder mount system. A new encoder mount is designed and installed on a Detroit Diesel 3-53 engine. The encoder mount is designed to ensure positive contact with the crankshaft while not allowing the mechanism to have the same type of failure that was previously identified. During the validation of the encoder, the push rod connected to the fuel injector rocker arm fails, preventing further validation of the system. The failure of the push rods is described.

SURFACE PIERCING PROPELLER PERFORMANCE
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This thesis addresses possible improvements in the efficiency (thrust) of surface piercing propellers, in particular with respect to the angle of the propeller shaft. Preliminary calculations based on the basic pitch/diameter geometry suggest that about 3-5% efficiency is lost if the shaft is parallel to the flow, compared to skewed a few degrees in the "paddlewheel" direction at certain speeds. More accurate calculations based on the lift characteristics of each blade, on the angle of attack and the flow of water over each blade, and given a set of basic assumptions on the overall performance of each blade as the blade enters and leaves the water, are used to determine the increase in efficiency. Full-scale experimental results are also presented in support of the calculations.

MECHANICAL ENGINEERING

ANALYSIS OF THE FAILURE OF A VACUUM SPIN-PIT DRIVE TURBINE SPINDLE SHAFT

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The Naval Postgraduate School's Rotor Spin Research Facility experienced a failure in the spring of 2005 in which the rotor dropped from the drive turbine and caused extensive damage. A failure analysis of the drive turbine spindle shaft is conducted in order to determine the cause of failure: whether due to a material or design flaw. Also, a dynamic analysis is conducted in order to determine the natural modes present in the system and the associated frequencies that could have contributed to the failure of the shaft. It is concluded that the failure was due to low cycle fatigue, a possible stress concentration is identified, and a torsional mode is found near the speed at which failure occurred.

THERMOMECHANICAL BEHAVIOR OF MONOLITHIC SN-AG-CU SOLDER AND COPPER-FIBER-REINFORCED SOLDER

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Solder joints provide both electrical and mechanical interconnections between a silicon chip and the packaging substrate in an electronic application. The thermomechanical cycling in the solder causes numerous reliability challenges, mostly because of the mismatch of the coefficient of thermal expansion between the silicon chip and the substrate. The actual transition to lead-free solders and the trend towards hotter-running, miniaturized and higher current density chips aggravate this situation. Therefore, improved solder joints, with higher resistance to creep and low cycle fatigue, are necessary for future generations of microelectronics. This study focuses on a thermomechanical behavior comparison between monolithic Sn-Ag-Cu, copper fiber and copper ribbon cylindrical reinforced solders. The composite solders are found to reduce the inelastic strain range of the joint relative to monolithic solder, but at the expense of increased stress range.

MECHANICAL ENGINEERING

FLOW FIELD SURVEYS IN A TRANSONIC COMPRESSOR PRIOR TO INLET STEAM INGESTION TESTS

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Investigating the effect of steam ingestion into an aircraft jet engine is necessary to improve understanding of stall and surge in transonic axial compressors. Specifically, to understand the "pop stall" phenomenon experienced by Naval fighter jet aircraft during steam catapult launches. Steam leakage from an aircraft carrier catapult system can be ingested into the intake and cause stall or surge in a jet engine upon takeoff. It is important to understand the conditions under which this occurs as the Navy prepares for the fielding of the single engine F-35C, the aircraft carrier variant of the Joint Strike Fighter. This project prepares the structure and instrumentation to investigate the inlet distortion and effects of steam ingestion on a transonic axial compressor. A compressor test facility, including mechanical equipment, a data acquisition system and a remote digital control system, is configured to test a transonic compressor rotor, similar to what will be used in the Joint Strike Fighter. Rotor inlet and exit velocity profiles are measured with a three-hole probe to obtain a set of baseline data before future experiments.

KEYWORDS: Compressor, Transonic, Steam Ingestion, Inlet Distortion, Turbomachinery, Pop Stall, Rotor

LASER VELOCIMETRIC FLOW MAPPING AND CHARACTERIZATION OF OIL MIST NOZZLES USED FOR BLADE EXCITATION IN HIGH CYCLE FATIGUE TESTING

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The flow patterns of two oil mist nozzles used in rotor blade excitation experiments are flow mapped using a traversing laser doppler velocimeter (LDV) system to determine the velocity. The overall characteristics are recorded photographically. The nozzles are operated in a vacuum test chamber and measurements are obtained at three different spray pressures, at three different axial distances from the nozzle exit. For a four gallon per hour (gph) "mini-mist" nozzle, a "referenced velocity" is defined, which is found to be constant within a hollow cone, and the cone geometry and oil flow rate change linearly with the oil supply pressure. A six gph "standard" nozzle gives a solid cone, but only gives a pattern free of liquid streaks at low pressures. Oil temperature affects this behavior. The analytic quantification of the spray pattern can be used to design specific blade excitation experiments in high cycle fatigue (HCF) vacuum spin tests.

KEYWORDS: Oil Jet Excitation, Mist Nozzle, Laser Doppler Velocimetry, Rotor Spin Pit, High Cycle Fatigue, Blade Excitation

MASTER OF SCIENCE
IN
METEOROLOGY AND PHYSICAL OCEANOGRAPHY

THE IMPACTS OF WEATHER FORECASTS ON MILITARY OPERATIONS: A SYSTEM FOR CONDUCTING QUANTITATIVE NEAR-REAL TIME ANALYSES

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Authors developed, tested and operationally implemented a web-based system for collecting and analyzing in near-real time weather forecast and observational data to assess the performance of forecasts and the operational impacts of forecasts. A major goal of the system is to quantify the impacts of weather forecasts on the planning, execution and outcomes of military operations. Tests and implementation are focused on the meteorology and oceanography (METOC) support provided by Naval Pacific Meteorology and Oceanography Detachment (NPMOD) Fallon to Naval Strike and Air Warfare Center (NSAWC) operations at Naval Air Station Fallon. Data are collected by NPMOD Fallon and entered via a web interface into a database at the Naval Postgraduate School (NPS), where the data are analyzed and results are reported in near-real time. The results include quantitative assessments of (1) forecasts used in planning NSAWC missions, (2) changes made during mission planning in response to forecasted weather, (3) deviations from mission plans that occurred in response to weather conditions actually encountered, (4) positive and negative impacts on missions due to forecasts, (5) METOC Tactical Decision Aid forecast accuracy and mission impacts, and (6) forecast performance and mission impacts with respect to specific weather factors.

KEYWORDS: Meteorology, Metrics, Quality, Performance, Operational Impacts Metrics, Mission Saved, Weapons Saved, METOC

CLIMATIC VARIATIONS OF THE CALIFORNIA CURRENT SYSTEM: APPLICATION OF SMART CLIMATOLOGY TO THE COASTAL OCEAN

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The Northern Oscillation Index (NOI), an atmospheric climate index relating climate variations in the tropical Pacific and Northeast Pacific, is used to selectively average output from the Parallel Ocean Climate Model (POCM 4C) for 1979-1998. Composites, or smart climatologies, are made representing El Nino (EN) and La Nina (LN) conditions, as well as a long term mean (LTM) average or traditional climatology, for November to March. Conditions in the California Current System (CCS) in the smart climatologies are consistent with large scale features noted in previously published studies of EN and LN. Overall, the patterns of anomalies (POCM 4C Smart Climatology minus POCM 4C Traditional Climatology) in salinity, temperature and currents are opposite in sign and magnitude between the EN and LN composites. This is expected for opposite phases of the same climate variation, and many of the model's EN/LN differences are found to be statistically significant. Therefore, using POCM 4C smart climatologies provides better estimates of ocean state and circulation patterns than traditional climatology. Such smart climatologies offer improved environmental information to Naval operational and strategic

planners. They are also useful for studying climate variations, and in improving boundary and initial conditions for ocean and atmosphere models.

AN INVESTIGATION OF NUMERICAL TECHNIQUES FOR THE FOURIER MATCHING METHOD ACOUSTIC SCATTERING MODEL

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The effects of extended precision computing and other numerical techniques are evaluated for the Fourier matching method (FMM) acoustic scattering model, initially developed by Assistant Professor D. Benjamin Reeder, CDR/USN, Naval Postgraduate School (NPS), and Professor Timothy K. Stanton (Massachusetts Institute of Technology (MIT)/Woods Hole Oceanographic Institute (WHOI)). Theory on acoustic scattering, reverberation, scattering models, conformal mapping, scatterer boundary conditions, floating point arithmetic, computational error and extended precision computing is presented as a foundation for research development. The paper presents an assessment of the effects of numerical techniques on model output with the initial expectation of obtaining a more accurate, converged solution at higher frequencies, higher modal combinations and greater eccentricities of scatterer shape. Comparisons to results from Reeder and Stanton (2004) demonstrate effects of executed techniques. Analysis includes an evaluation of the relationship between variable precision settings and computational time, gains in the useful frequency regime of the FMM and numerical analysis benefits. Demonstrated techniques confirm that increased precision has a positive effect on model performance. The utility of other numerical techniques is discussed, and limitations of current computer systems and other shortfalls are illustrated. A feasibility assessment for Navy use of the FMM and recommendations for further improvements to the FMM are included.

ACCURACY OF ATLANTIC AND EASTERN NORTH PACIFIC TROPICAL CYCLONE INTENSITY GUIDANCE

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Five statistical and dynamical tropical cyclone intensity guidance techniques available at the National Hurricane Center during the 2003 and 2004 Atlantic and eastern North Pacific seasons are evaluated within three intensity phases: (i) formation, (ii) early intensification, and (iii) decay.

During the formation phase, the Decay Statistical Hurricane Intensity Prediction (DSHIPS) technique is the best technique in both basins. When the forecast errors during formation exceed +/- 10 kt, the statistical techniques tend to over-forecast and the dynamical models tend to under-forecast. Whereas DSHIPS was also the best technique in the Atlantic during the early intensification stage, the Geophysical Fluid Dynamics Laboratory model was the best in the eastern North Pacific. All techniques under-forecast periods of rapid intensification and the peak intensity, and have an overall poor performance during decay-reintensification cycles in both basins. Whereas the DSHIPS was the best technique in the Atlantic during decay, none of the techniques excelled during the decay phase in the eastern North Pacific. All techniques tend to decay the tropical cyclones in both basins too slowly, except that the DSHIPS performed well (13 of

15) during rapid decay events in the Atlantic. Similar error characteristics are found in the western North Pacific.

KEYWORDS: Tropical Meteorology, Tropical Cyclone Intensity, Tropical Cyclone Intensity Change Forecast Techniques, Numerical and Statistical Intensity Change Guidance

ANALYSIS OF HIGH-RESOLUTION COUPLED OCEAN ATMOSPHERE MESOSCALE PREDICTION SYSTEM (COAMPS) WITH OBSERVED METEOROLOGY AND OCEANOGRAPHY (METOC) DATA TO DEMONSTRATE ATMOSPHERIC IMPACT ON EM PROPAGATION
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Current U.S. Navy Special Warfare and submarine concepts of operations (CONOPS) dictate that in-situ environmental data collection is limited or not possible. Therefore, predicted data from operational models, such as the Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS), are essential to estimate the impacts of environmental conditions on the detection of enemy targets and counter-detection by radar and optical sensors. This study compares the use of high-resolution COAMPS data and in-situ shipboard and rawinsonde measurements for detection prediction purposes. The evaluation is based on data from Fleet Exercise SILENT HAMMER, conducted off the southern California coast near San Clemente Island in October 2004. An instrumented vessel was used for continuous surface layer data collection and frequent rawinsonde launches. COAMPS meteorological predictions were obtained at 3- and 9-km resolutions. The shipboard and COAMPS data provides refractivity profiles that are then used with propagation models within the Builder and AREPS graphical user interfaces to obtain signal-to-noise and propagation loss versus range diagrams. An increase in the horizontal resolution of COAMPS from 9- to 3-km does not significantly improve the prediction of meteorological variables within the lower marine boundary layer. However, counter-intuitively, the higher resolution does slightly improve detection range estimates.

KEYWORDS: COAMPS, EM Propagation, Boundary Layer, Refractivity, AREPS, Interactive Scenario Builder, Mesoscale Models

WAVELET ANALYSIS OF BIOACOUSTIC SCATTERING AND MARINE MAMMAL VOCALIZATIONS
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Wavelets have been used in numerous geophysical studies, but few have examined their applicability to underwater acoustic signals. Wavelet transforms can remove noise from a given time series and allow data analysis at multiple levels of resolution. This unique ability is exercised as a feasible application to the signals in this thesis: a reflected scattered signal from a swim-bladder-bearing fish, alewife (Alosa pseudoharengus) and several Odontocetes vocalizations. Both studies reveal that wavelet-based techniques show potential in providing viable information for these acoustic signals, despite the lack of statistical analysis. The alewife portion shows a reasonable first order approximation to the absolute target strength and to the time delay correlation caused by the spatial separation of scattering features in the fish. The marine mammal application shows a possible real time method to estimate the mammal's range using the root mean square (RMS) energy of the decomposed signal. Because of wavelet function mismatch, both studies conclude that more extensive research is necessary to develop these techniques into systematic processes.

METEOROLOGY AND PHYSICAL OCEANOGRAPHY

RIP CURRENT/CUSPATE SHORELINE INTERACTIONS VIA VIDEO IMAGERY
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The interaction between rip channels and cuspate shoreline is examined by analyzing data obtained by the Naval Postgraduate School Imaging System (NAPSIS) during the winter of 2004-2005 in Southern Monterey Bay. Video imaging data is used to determine rip channel locations. The rip fields had constantly changing shapes and sizes, and the beach underwent a transformation from a transverse-barred-beach (TBB) to a longshore-bar-trough (LBT) state. Mean rip spacing is determined to be 173 and 258m respectively for the two different beach states (TBB and LBT).

Directional wave spectra measured at the offshore National Oceanic and Atmospheric Administration (NOAA) buoy in deep water are refracted to the 10m depth contour at the actual study site. Estimated alongshore sediment transport, Qs, is calculated using the refracted wave data. The hypothesis that rip channel migration is due to alongshore sediment transport is qualitatively confirmed. Little or no migration occurs when Qs values are close to zero. Migration rates are calculated over a three week period during a time of high rip mobility with an average migration rate of 3.2m per day. The rip channel orientations are constantly changing. Three distinct rip channel shapes are common: straight, slanted or C shaped. The rip channels tend to slant in the opposite direction of the estimated sediment transport, since the rip channels migrate more rapidly at their base (nearest to shore) and more slowly offshore.

The hypothesis that the mega-cusps on the beach are erosional features of rip currents is tested by cross-correlating the 2m beach contour obtained using GPS beach surveys with an alongshore video pixel intensity line. During a time of steady rip channel migration, it is found on average that the cusps lagged the rip channels by 50m with a maximum correlation near one. Assuming the system is in steady state, a response time of 14.7 days is obtained by dividing the lag distance by the average migration rate.

MASTER OF SCIENCE
IN
MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

DESIGN AND OPERATIONAL ASPECTS OF AUTONOMOUS UNINHABITED COMBAT AERIAL VEHICLES
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A family of advanced weapon systems that deserves special attention comprises aerial autonomous weapons called unmanned combat aerial vehicles (UCAVs), which are characterized by the ability to loiter in the target area, sense the targets, acquire the targets and then engage them. Modeling this combination of capabilities in a specific operational setting is necessary for addressing design and operational issues of this weapon. This work focuses on the development of an analytic probability model that captures key aspects of the autonomous weapon systems' engagement process. Special attention is given to simultaneous attack occurrences, imperfect battle damage assessment and attack coordination properties. The model is a continuous-time Markov Chain and for its implementation a state generator and an algorithm that computes the transition and limiting probabilities is developed and programmed in Java-based software. The Markov-model derives values for several measures of effectiveness (MOEs) and the average engagement time. Different operational scenarios and design configurations are examined in a sample analysis to demonstrate the model's capabilities. Tradeoffs among sensing, data processing capabilities, vulnerability and lethality of UCAVs are explicitly represented with respect to selected MOEs.

KEYWORDS: UCAV, Autonomous, Marcov Model, Simultaneous Attacks

EVALUATING SUNNI PARTICIPATION IN AN ELECTION IN A REPRESENTATIVE IRAQI TOWN
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What were once considered purely civilian considerations are today increasingly significant matters to international peace and security. Conflicts within states and urban encounters make civilian considerations particularly troublesome for military forces sent to stabilize a country. Along with these changes in the patterns of war, the techniques that are used in operations have also changed. Stability operations are an application of military power to influence the political and civilian environment. Often these take the specific form of peacekeeping or peace support operations. Peace Support Operations (PSO) are military operations to support, provide and sustain a long-term political settlement. PSO and conventional war have different characteristics. It is possible to generalize the main purpose of conventional war as to "defeat the enemy," whereas peacekeeping attempts to "win the peace." At the tactical level, some of the goals of peacekeeping missions are to help and protect civilians, to avoid violence and escalation and to ensure the safety of the public with civilians in a stability operation rather than in combat. Secondly, stability operations are executed in a more diverse range of environments than those of conventional war. Furthermore, depending upon the mandate, soldiers must use different sets of engagement rules when interacting with civilians.

MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

FORWARD OBSERVER PERSONAL COMPUTER SIMULATOR 2

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Due to declining budgets and decreases in ammunition allowances, the opportunity to conduct live fire artillery training has been greatly reduced. Available simulation trainers are either outdated, require specialized contractor support or are not deployable. Forward Observer Personal Computer Simulator (FOPCSim) was developed at no cost, is freely available, takes advantages of modern 3D graphics, eliminates costly contractor support and will run on laptops in support of deploying units. The simulator provides users with real-time performance feedback based on the Marine Corps Training and Readiness standards and was designed according to a cognitive task analysis of the call for fire procedures. To evaluate how well FOPCSim trains the call for fire procedures, an experiment is conducted at The Basic School in Quantico, Virginia. FOPCSim is used in place of the current simulation: Training Set, Fire Observation (TSFO), to evaluate its training effectiveness. The results of the experiment show that those students who used FOPCSim scored better on the Supporting Arms Exam than those who used the TSFO for the same amount of time. By eliminating the overhead associated with most simulators, FOPCSim allows users to perform the call for fire procedures with a high degree of repetitiveness, which is needed to train this type of task.

SLEEP AND PREDICTED COGNITIVE PERFORMANCE OF NEW CADETS DURING CADET BASIC TRAINING AT THE UNITED STATES MILITARY ACADEMY

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The amount of sleep per day among new cadets at West Point during Cadet Basic Training (CBT) is investigated. Sleep is measured using actigraphy. Results indicate that new cadets slept an average of approximately 340 minutes or 5 hours, 40 minutes per night. Results are compared with survey data to determine whether or not reported sleep prior to arrival at West Point matched measured sleep at CBT. Findings indicate that the study population is sleep-deprived during CBT. Additionally, the results show that, on average, new cadets receive 2 hours, 6 minutes less sleep per night during CBT than before their arrival at West Point. The findings also indicate that sleep achieved is not due to the various comparison factors: gender, race, company, age, recruited athlete and morningness/eveningness preference.

MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

SPATIAL ORIENTATION AND FAMILIARITY IN A SMALL-SCALE REAL ENVIRONMENT USING PC-BASED VIRTUAL ENVIRONMENT TECHNOLOGY

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Conducting training in a new or unfamiliar environment requires a certain amount of time to acquire the necessary spatial orientation and familiarity to that environment's physical layout. This thesis explores the effects of exposing individuals to a PC-based virtual replication of a small-scale real-world training environment to determine if such exposure has any effect on an individual's ability to acquire the necessary spatial orientation and familiarity with the real world environment. In this thesis, individual spatial orientation and familiarity to the layout of the real world environment are measured using a set of retrieval tasks conducted in the real environment and by development of a sketched map of that environment. Establishing a link between an individual's ability to gain an acceptable level of spatial orientation and familiarity with a real world environment by first exposing them to a PC-based virtual replication of that environment is vital to the future of video game development and virtual simulation technologies used for training in the military.

KEYWORDS: Spatial Orientation, Environment Familiarization, PC-Based Virtual Environment, Training in Virtual Environments, Spatial Knowledge Acquisition, Firefighting Trainer, Virtual Environment Exposure

GAMES FOR TRAINING: LEVERAGING COMMERCIAL, OFF-THE-SHELF (COTS), MULTI-PLAYER GAMING SOFTWARE FOR INFANTRY SQUAD COLLECTIVE TRAINING

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Combat arms units (both Marine and Army) often do not have enough people, time and resources to properly train collective tasks at the squad. Resources are often retained by higher headquarters due to tight deployment schedules, land restrictions, logistics constraints and a myriad of other reasons. Due to the current operational demands of combat arms brigades and regiments, the reality of limited resources is often a contributing factor in poor performance at the squad level. Leaders at all levels will need to look for innovative ways to sustain training levels at the small unit level. The scope of this study examines the collective and leader tasks required for successful execution of Infantry squad missions (using the Army Training and Evaluation Plan – ARTEP 7-8 Drill), and how those tasks could be trained with the use of commercial, off-the-shelf, multi-player gaming software. Using a group of second lieutenants enrolled at the U.S. Army Infantry Officer Basic Course, a training event is conducted using a commercial game as an additional training event to prepare them for their squad maneuver live-fire event. It is found that the squads that conducted the additional training performed better than the squads that did not receive the games-training, and the level of user acceptance by the test squads is high. Overall, researchers demonstrate that the potential of using commercial games can yield positive results, but the training event needs to be resourced properly (with training officers and NCOs present), structured (to include an after-action review process) and the platform needs to be accepted as a training venue by the users in order to gain any value from the event. Future work needs to address games-based training over the length of an entire training cycle, the type of platform best suited for training (PC, console or handheld devices) and what additional skills that this type of training can be used to train.

MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

**COMPARISON OF A DISTRIBUTED OPERATIONS FORCE TO A TRADITIONAL FORCE
IN URBAN COMBAT**

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In this thesis, suitability of Distributed Operations (DO) for urban combat operations is explored by analyzing the results of simulations created in Map Aware Non-uniform Automata (MANA). The employment of a DO is compared to employment of a traditional Marine infantry platoon in an urban combat scenario based upon data obtained from Operation al-Fajr, conducted in Fallujah, Iraq, in November 2004. The study also examines the effects caused by varying the terrain to that of Range 200, constructed at the Marine Air Ground Training Command, Twentynine Palms, California. Modeling insights, obtained by surveying Marines with urban combat experience in Iraq, tie into the research effort.

This research indicates that the DO is marginally more effective than a Traditional Platoon in urban combat. DO also shows a greater sensitivity to combat outcomes due to urban density, and produces significantly better results in terrain with a lesser density of urban structures.

KEYWORDS: Agent-Based Models, MANA, Project Albert, Design of Experiment, Urban Combat, Military Operations on Urban Terrain, MOUT

**SUPPORTING A MARINE CORPS DISTRIBUTED OPERATIONS PLATOON:
A QUANTITATIVE ANALYSIS**

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This research analyzes the critical logistical requirements of a U.S. Marine Distributed Operations Platoon with the goal of developing a sustainable support plan. The development of Distributed Operations (DO) is one of the Marine Corps' major transformational efforts designed to make infantry units more lethal by leveraging training and technology to allow more dispersed and intelligence driven operations. Since a DO platoon will operate far from secure lines of communication and support bases, logistically supporting it will be challenging. Through the use of simulation, statistical analysis and logistical modeling, this thesis identifies critical factors and capabilities that are important to the sustainment of a DO platoon operating from a Marine Expeditionary Unit (MEU). The research concludes with a feasible support concept combined with the means to assess the effect that supporting a DO platoon has on other MEU missions. Results indicate that quick response time and dedicated support assets from the supporting agency, typically augmented by MEU helicopters, are critical to the success of a DO platoon. This limits the flexibility of the MEU aviation element to support other MEU missions. The biggest payoff in improving logistical effectiveness is given by reducing the response time.

KEYWORDS: Distributed Operations, Infantry Platoon, Marine Expeditionary Unit, Transformation, Project Albert, Data Farming, Agent-Based Model, MANA, Maui High Performance Computing Center, Marine Corps Warfighting Lab, Wargame, Quantitative Analysis

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OPERATIONS RESEARCH

MEDICAL EVACUATION AND TREATMENT CAPABILITIES OPTIMIZATION MODEL

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In this thesis, a new model called Medical Evacuation and Treatment Capabilities Optimization Model (METCOM) is developed. The model is designed as a user-friendly optimization model that augments current simulations and assists in optimizing efficiencies, allowing for redistribution, restructuring or realignment of medical resources and materials to better meet requirements elsewhere in the area of operations (AO). The model addresses variations in capabilities and policies of the medical evacuation and treatment system (METS) in order to discern effects on desired medical outcomes. A combination of descriptive and prescriptive multi-period models are utilized in order to identify policy effect on key measures of effectiveness (MOEs) and then fully optimize treatment and evacuation capacities for given casualty flows. Results provide medical planners and decision makers with coherent and relevant data allowing for the flexibility to employ a broad range of policies and capacities that would best meet the objectives of saving warfighters' lives and minimizing resource capacity costs required while supporting the overall operational plan.

KEYWORDS: Medical Regulating, Multi-Period Network, Inter-Temporal Network, Health Service Support, Medical Evacuation and Treatment System, Linear Optimization, Military Health System, Echelons of Care, Levels of Care, Patient Evacuation, Optimization Model, Medical Logistics

OPTIMIZING THE LONG-TERM CAPACITY EXPANSION AND PROTECTION OF IRAQI OIL INFRASTRUCTURE

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A tri-level defender-attacker-defender optimization model that prescribes how Iraq's oil infrastructure can, over time, be expanded, protected and operated, even in the face of insurgent attacks, is introduced. The outer-most defender model is a mixed-integer program that, given a set of anticipated insurgent attacks, specifies a quarterly capital expansion, defense and operation plan to maximize oil exports over a decade-long planning horizon. The intermediate attacker model, observing the outer defender plans, is a mixed integer program that re-optimizes insurgent attacks to minimize export flow. The inner-most defender model is a linear program that re-directs flow in response to insurgent damage. Open-source descriptions of current Iraqi oil infrastructure and reasonable estimates of the costs to expand capacity and/or defend operating assets, and reduce vulnerability to attacks, are used. The tri-level model is solved by converting it into an equivalent bi-level model and applying decomposition. For a range of scenarios, the best allocation of effort between improving and defending oil export infrastructure is determined.

KEYWORDS: DIAMOND, Oil Infrastructure, Oil Pipeline, Capital Allocation and Expansion, Iraq, Tri-Level Attacker-Defender-Attacker Model, Cost Estimation, Mixed Integer Programming

OPERATIONS RESEARCH

AN ENHANCED IMPLEMENTATION OF MODELS FOR ELECTRIC POWER GRID INTERDICTION

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This thesis evaluates the ability of the Xpress-MP software package to solve complex, iterative mathematical-programming problems. The impetus is the need to improve solution times for the VEGA software package, which identifies vulnerabilities to terrorist attacks in electric power grids. VEGA employs an iterative, optimizing heuristic, which may need to solve hundreds of related linear programs. This heuristic is implemented in the General Algebraic Modeling System (GAMS), whose inefficiencies in data handling and model generation mean that a modest, 50-iteration solution of a real-world problem can require over five hours to run. This slowness defeats VEGA's ultimate purpose, evaluating vulnerability-reducing structural improvements to a power grid.

It is demonstrated that Xpress-MP can reduce run times by 60-85% because of its more efficient data handling, faster model generation and the ability, lacking entirely in GAMS, to solve related models without regenerating each from scratch. Xpress-MP's modeling language, Mosel, encompasses a full-featured procedural language, also lacking in GAMS. This language enables a simpler, more modular and more maintainable implementation.

The value of VEGA's optimizing heuristic is also demonstrated by comparing it to rule-based heuristics rules adapted from the literature. The optimizing heuristic is much more powerful.

KEYWORDS: Electric Power Grids, Network Interdiction, Mixed Integer Programming, GAMS, Xpress-MP

EXPLANATORY FACTORS FOR MARINE CORPS AVIATION MAINTENANCE PERFORMANCE

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The thesis identifies F/A-18 squadron characteristics that are important predictors of maintenance performance and draws insights on the linkage between the utilization of engineering and technical services (ETS) and maintenance performance measures. Statistical analysis is conducted to identify squadron characteristics that have a detectable contribution to the variability of the performance measure man-hours per maintenance action, and how much additional variability is explained by the squadron that is not accounted for by the squadron characteristics already considered.

Thirty months of data are collected for thirteen active duty Marine Corps F/A-18 squadrons. Regression is used to model man-hours per maintenance action as a linear combination of explanatory variables that describe the squadrons in terms of manpower, inventory and ETS metrics. The test for significance indicates that the model developed in this study is highly likely to have better explanatory power than an intercept-only (average) estimate of the response variable. The study concludes with recommendations for data collection methods that would facilitate the correlation of squadron characteristics to ETS utilization. Critical to the success of this approach is the linkage of ETS utilization to specific squadron maintenance activities, and the development of methods to quantify maintainer training currency.

KEYWORDS: Aviation, Squadron, Maintenance, Performance, Readiness, NATEC, ETS, Metrics

OPERATIONS RESEARCH

A STATISTICAL ANALYSIS OF INDIVIDUAL SUCCESS AFTER SUCCESSFUL DEFENSE LANGUAGE INSTITUTE FOREIGN LANGUAGE CENTER TRAINING

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The Defense Language Institute Foreign Language Center (DLIFLC) trains students in various foreign languages and dialects for the Department of Defense (DoD). The majority of students are first-term enlistees in the basic program. This study uses classification trees and logistic regression to understand the military, academic and personal characteristics that influence first-term success after successfully completing DLIFLC training. Success is defined as completing a first-term enlistment contract and maintenance of language proficiency. DLIFLC management is interested in the difference in success for individuals who graduated DLIFLC via the different training pipelines. Students graduate by completing the program as originally assigned, or by recycling, re-languaging or taking post-Defense Language Proficiency Test (DLPT) enhancement training multiple times and in multiple combinations due to various academic, administrative or other reasons. Sixty-three percent of students graduated. Only 45% of who graduated were successful post-DLIFLC. Results of the study identify several factors influential in predicting success: service affiliation, contract lengths and gender. Training pipelines are slightly influential. Individuals in the Army have the worst odds of success. Contract lengths greater than four years have lower odds of success. Males have higher odds of success than females.

KEYWORDS: Defense Language Institute Foreign Language Center, DLIFLC, Defense Language Institute, DLI, Military Attrition, Military Foreign Language Training

CARDIOVASCULAR RISK COMPARISONS OF NON-STEROIDAL ANTI-INFLAMMATORY AGENTS IN THE TRICARE POPULATION

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This report examines differences in risk of myocardial infarction and stroke (cardiovascular events) between cyclooxygenase-2 (COX-2) inhibitors rofecoxib, celecoxib and valdecoxib, and the traditional nonsteroidal anti-inflammatory agents (NSAIDs) naproxen and ibuprofen, as well as meloxicam, a preferential COX-2 inhibitor. The population studied is the Department of Defense (DoD) TRICARE beneficiary population of age greater than 40 during the study period. In September 2004, rofecoxib, a COX-2 inhibitor, was removed from the market due to an increased risk of cardiovascular events. In February 2005, the Food and Drug Administration (FDA) examined the entire class of COX-2 inhibitors and recommended that valdecoxib also be withdrawn from the market. According to Department of Defense TRICARE prescription records, COX-2 inhibitor prescription numbers were increasing rapidly and more than $7 million was spent on these agents in July 2004 alone. Logistic regression is used to analyze TRICARE prescription and diagnosis data from calendar years 2002, 2003 and 2004 for cardiovascular event risk comparisons among various NSAIDs. Rofecoxib is found to have a significantly increased risk of cardiovascular events when compared with all other medications in the study, including valdecoxib. Odds ratios for comparison with valdecoxib, celecoxib, meloxicam, ibuprofen and naproxen are 1.09, 1.14, 1.15, 1.28 and 1.23. Valdecoxib shows a significant increase compared to ibuprofen, naproxen and celecoxib (odds ratios 1.21, 1.16 and 1.06). Ibuprofen shows a significantly decreased risk relative to all medications except naproxen. When considering only cardiovascular risk, this study suggests that prescribers should consider ibuprofen or naproxen as the primary agent of choice, with meloxicam and celecoxib as reasonable second choices. Ultimately, the decision must also weigh the patient's risk of gastrointestinal side effects and cost of therapy.

OPERATIONS RESEARCH

OPTIMIZING THE DISTRIBUTION OF UNITED STATES ARMY OFFICERS
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The U.S. Army distributes its 51,000 competitive category officers among manning targets specified by location, rank and skill, which change over time in response to changing requirements. The officer inventory also changes over time and does not exactly match the manning target requirements. The Army responds to imbalances by redistributing officers in order to provide each location with the minimum required officers while minimizing the number of unfilled targets and excess officers at each location. This thesis focuses on branch officers, branch targets and generalist targets with ranks from Branch Qualified Captain to Colonel. Using data provided by the Army, an integer programming model called Distributor is formulated. When Distributor allows all officers in the inventory to move, it finds only 340 unfilled targets, but this requires 4,688 or 28% of the inventory to move. The number of moves is reduced by using Distributor in two sequential steps. The first step optimally distributes officers at each location and identifies the excess officers and unfilled targets at each location. The second step takes the excess officers and distributes them to unfilled targets at other locations. The two-step leaves only 346 targets unfilled (six more) but requires only 1,373 or 8% of the inventory to move. By allowing rank substitution, Distributor can reduce the unfilled targets to 70.

UNMANNED AERIAL VEHICLE SURVIVABILITY: THE IMPACTS OF SPEED, DETECTABILITY, ALTITUDE AND ENEMY CAPABILITIES
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Second Reader: Maj George E. Ehlers, USMC, Marine Corps Systems Command

Warfighters are increasingly relying on Unmanned Aerial Vehicle (UAV) systems at all levels of combat operations. As these systems weave further into the fabric of our tactics and doctrine, their loss will seriously diminish combat effectiveness. This makes the survivability of these systems of utmost importance. Using agent-based modeling and a Nearly Orthogonal Latin Hypercube design of experiment, numerous factors and levels are explored to gain insight into their impact on, and relative importance to, survivability. Factors investigated include UAV speed, stealth, altitude and sensor range, as well as enemy force sensor ranges, probability of kill, array of forces and numerical strength. These factors are varied broadly to ensure robust survivability results regardless of the type of threat. The analysis suggests that a speed of at least 135 knts should be required and that increases in survivability remain appreciable up to about 225 knts. The exception to the dominance of speed is extremely high-capability enemy assets. In this case, stealth becomes more important than speed alone. However, the interactions indicate that as both speed and stealth increase, speed yields a faster return on overall survivability and that speed mitigates increased enemy capabilities.

OPERATIONS RESEARCH

THE EFFECTS OF QUALITY AND TIMELINESS OF TARGETING INFORMATION ON SUBMARINE EMPLOYMENT OF LONG RANGE ANTI-SHIP CRUISE MISSILES

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Anti-ship cruise missiles (ASCMs) are proliferating throughout the world, with some nations gaining the potential to launch them from submarines. The long range of these missiles implies that the submarine would rely on target detections from other forces. Communication delays and accuracy of locating data influence shot accuracy.

This thesis uses a maneuvering target statistical tracker model (MTST) of target motion and indicates that the submarine can conduct an effective launch with accurate locating information even with long communications delays. The analysis shows that significant degradation of the probability of target intercept occurs for an alerted or evading target.

The analysis then determines how this is affected by the presence of other potential targets for the missile. Two assumptions are made about the performance of the ASCM seeker. A simplistic seeker that selects a target at random performs very poorly if other naval escorts and random neutral shipping are encountered. A more intelligent seeker that uses information about the relative size of the ships and attacks the largest one results in greatly improved performance.

KEYWORDS: MTST, ASCM, Submarine, Cruise Missile, Kalman Filter

EXPLORING THE EFFECTIVENESS OF THE MARINE EXPEDITIONARY RIFLE SQUAD

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This study explores the effectiveness of the Marine Expeditionary Rifle Squad (MERS) in support of Distributed Operations in urban terrain. The Marine Corps is evaluating the Distributed Operations concept as a solution to new threats posed in current operations. In order to employ distributed tactics, a more effective and capable Marine Rifle Squad is needed. The MERS concept seeks to increase the effectiveness of the current rifle squad, enabling smaller, more lethal and more survivable units. Those issues are explored using agent-based modeling and data analysis. The most significant finding is that the MERS must be evaluated as a system; factors cannot be analyzed in isolation. The two factors that most affect the effectiveness are survivability and lethality. Maximizing these two factors leads to the lowest friendly casualties, highest enemy casualties, and highest probability of mission success. Agent-based modeling provides the maximum flexibility and responsiveness required for timely insights into small unit combat.

KEYWORDS: Marine Expeditionary Rifle Squad, MERS, Distributed Operations, DO, Urban Terrain, Fallujah, Operation Al Fajr, Nearly-Orthogonal Latin Hypercube, NOLH, Agent-Based, MANA, Project Albert

OPERATIONS RESEARCH

APPLIED WARFIGHTER ERGONOMICS: A RESEARCH METHOD FOR EVALUATING MILITARY INDIVIDUAL EQUIPMENT

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Design and implement a laboratory and establish a research method focused on scientific evaluation of human factors considerations for military individual equipment under both laboratory and field conditions. This integrated approach for laboratory and field conditions is the first of its kind for military human factors research, enabling an unparalleled degree of scientific rigor in the collection of empirical human factors data. This effort includes: 1) a state-of-the-art usability laboratory designed specifically for quantitatively evaluating military individual equipment; 2) a rugged, embarkable, fully self-contained, portable usability laboratory for field research in military environments; 3) a codified manual for using the two main configurations (stationary and portable) of the usability laboratory, written for the beginning usability researcher; 4) a set of validated procedures for applying sound human factors principles, and traditional and non-parametric statistics to the specific problem of usability testing of military individual equipment; 5) a proof-of-concept practical application of the laboratory and procedures to a specific problem, namely the usability testing of ruggedized personal digital assistants (RPDAs) designed for United States Special Forces operations.

KEYWORDS: Devices, Ergonomics, Handheld, Human Factors, Individual Equipment, Noldus, Observer, PDA, Personal Digital Assistant, RPDA, Usability, Usability Laboratory, Usability Testing

DYNAMIC ESCAPE ROUTES FOR NAVAL SHIPS

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This thesis addresses the problem of optimal evacuation of a naval ship. Use of a dynamic escape-route system that employs a signaling system to adapt the emergency egress process to the instigating contingency is proposed.

The evacuation process is represented by a nonlinear network optimization model with an objective function that integrates two conflicting goals: the average evacuation time and the ship's integrity. The nonlinearity in the model results from (a) speed being a nonlinear function of concurrent flow on passageways, and (b) delays caused by opening closures. Researchers also account for counter-flows and passageways used by repair parties.

The problem is heuristically solved through an iterative process that updates speeds and delays as it proceeds, and dynamically adds valid inequalities to avoid counter-flows. A bound on the solution quality is obtained by solving the problem under optimistic conditions.

Compared to static routes in a modern frigate, model solutions show that dynamic routes can improve the average evacuation time by 20%, reduce the time of the last evacuee by 25% and improve ship integrity. It is also demonstrated that even greater improvements are achievable with minor design changes in the ship.

KEYWORDS: Military Problems, Ship Evacuation, Network Optimization

MASTER OF SCIENCE
IN
PHYSICAL OCEANOGRAPHY

BATHYMETRIC MAPPING WITH QUICKBIRD DATA
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Two algorithms are used to determine bathymetry in the littoral region using QuickBird multi-spectral satellite observations. The algorithms determine water-leaving radiance and convert this to water depth values. The first algorithm uses a ratio of two wavebands and the second uses the sum of several wavebands. Relative bathymetric errors are determined for the clear water of Looe Key (U.S.) and the turbid water of Plymouth Sound (UK). Bathymetric measurements from LIDAR and chart data are compared to derived depths to assess their accuracies. An amended version of the ratio method is proposed for use in turbid water to improve accuracy. The results show that the standard ratio and turbidity algorithms have a relative error of 11.7% and 16.5% respectively in clear water. In turbid water the average error of the turbidity algorithm is 11.6% and the amended ratio algorithm average error is 13%.

KEYWORDS: Aerosol Optical Depth, AOD, Bathymetry, ENVI, HYDROLIGHT, LIDAR, QuickBird, Ratio Algorithm, Stratified Genetic Algorithm

DETECTION AND RESOLVABILITY OF PULSED ACOUSTIC SIGNALS THROUGH THE SOUTH CHINA SEA BASIN: A MODELING ANALYSIS
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Sponsored by the office of Naval Research (ONR), the Windy Islands Soliton Experiment (WISE) is designed to measure acoustic propagation and physical oceanography commencing April 2005-2006. As part of this experiment, two deep water moorings with acoustic transceivers (source-receiver combinations) will be placed in the South China Sea deep basin 160 km apart. These transceivers will transmit and receive phase-modulated signals (pulses after signal processing) over the year attempting to capture multi-scale variability in transmission loss and examine the progression of internal tides within the basin through tomographic inverse techniques. Acoustic arrival structure modeling is conducted to discern whether a detectable and resolvable signal is to be expected and for signal design. Using a stochastic inverse approach, the inversion is used to determine vertical structure, spatial resolution and uncertainty associated with the tomographic mapping of the internal tide.

KEYWORDS: Soliton, Oceanography, Internal Tide, Acoustic Propagation, Ray Theory, Pulsed Acoustic Signals, South China Sea, Acoustic Detection, Modeling Analysis

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MASTER OF SCIENCE
IN
PHYSICS

HIGHER-ORDER MODES IN FREE ELECTRON LASERS
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Free electron laser theory is developed from the Maxwell and Lorentz force equations; the properties and characteristics of the laser are reviewed. The wave equation is solved for the fundamental Gaussian mode, and higher-order modes in Cartesian and cylindrical coordinate spaces, yielding expressions for the complete and orthogonal basis sets of Hermite- and Laguerre-Gaussian beams. Motivated by the evident inclusion of higher-order modes in free electron laser simulations, a tool is developed for the higher-order (in particular Laguerre-Gaussian) modal analysis of simulated free electron laser beams.

KEYWORDS: Free Electron Laser, Higher-Order Modes, Laguerre-Gaussian Modes

MASTER OF SCIENCE
IN
SOFTWARE ENGINEERING

**ROLE-BASED ACCESS CONTROL FOR COALITION PARTNERS IN
MARITIME DOMAIN AWARENESS**

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Each computer on a network has an OS Fingerprint that can be collected through various applications. Because of the complexity of network systems, vulnerabilities and exploitations of the same to gain access to systems will always be a problem. Those wishing to attack a system can use the OS Fingerprint to identify the types of vulnerabilities and software exploits that will be effective against the system. This paper discusses how system vulnerabilities are exploited and used by network attackers. Because OS Fingerprints are one of many tools network attackers use to identify and attack a system, concealing a system's OS Fingerprint is an important part of securing that system. To demonstrate the capability of concealing the OS Fingerprint of a system, a prototype system is developed. This prototype changes the OS Fingerprint of a Linux system so that it matches a Windows NT system.

KEYWORDS: Network Security, TCP/IP, OS Fingerprinting, Computer Security, Homeland Defense, Homeland Security

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**SELF-DIAGNOSTICS DIGITALLY CONTROLLED PACEMAKER/DEFIBRILLATORS: A
DESIGN PLAN FOR INCORPORATING DIAGNOSTICS AND DIGITAL CONTROL IN THE
SCHEMA OF A PACEMAKER/DEFIBRILLATOR DESIGN**

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This research addresses the need for a pacemaker/defibrillator that could perform an automatic system self-diagnostics check to assure operational functionality and give doctors a chance to assess a patient's status in the event they are experiencing complications, as pointed out in an article in the journal *Health Scout*, which stated that "St. Jude Medical, Inc., the nation's second-largest pacemaker manufacturer, has warned doctors that at least 90 of its pacemakers being used by heart patients could stop emitting the electrical signal that regulates heartbeat." The proposed functionality would also serve the military in determining the whereabouts or state of being of an individual on the battlefield.

This thesis investigates the use of Unified Modeling Language (UML) diagrams, object-oriented analysis and design, and Structured Query Language (SQL) to develop the high level architecture of a system to store and retrieve digital/wireless communication information from a pacemaker/defibrillator or other device, and to alert medical personnel when a person is experiencing health problems. Requirements and architectural design of the Self-Diagnostics Digitally Controlled Pacemaker/Defibrillator Device (SDDCPDD) are presented. Applications of the SDDCPDD design concept for military missions are explored.

KEYWORDS: UML, OOA, OOD, SQL, Pacemaker, Defibrillator, SDDCPDD

MASTER OF SCIENCE
IN
SPACE SYSTEMS OPERATIONS

VEGETATION IDENTIFICATION WITH LIDAR
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LIDAR data taken over the Elkhorn Slough in central California are analyzed for terrain. The specific terrain element of interest is vegetation, and in particular, tree type. Data were taken on April 12, 2005, over a 10 km × 20 km region of mixed use agriculture and wetlands. Time return and intensity are obtained at ~2.5 m postings. Multi-spectral imagery from QuickBird is used from a 2002 imaging pass to guide analysis. Ground truth is combined with the orthorectified satellite imagery to determine regions of interest for areas with eucalyptus, scrub oak, live oak and Monterey Cyprus trees. LIDAR temporal returns are used to distinguish regions with trees from cultivated and bare soil areas. Some tree types are distinguished on the basis of the relationship between first/last extracted feature returns.

The otherwise similar eucalyptus and Monterey Cyprus are distinguished by means of the intensity information from the imaging LIDAR. The combined intensity and temporal data allow accurate distinction between the tree types, a task not otherwise practical with the satellite spectral imagery.

**DIRECT IMAGING OF MINORITY CHARGE CARRIER TRANSPORT IN
LUMINESCENT SEMICONDUCTORS**
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A quantitative method for extracting minority carrier diffusion and drift lengths is developed and demonstrated in a heavily-doped semiconductor heterostructure. This method advances the high resolution transport imaging technique, yielding key material parameters with a single, non-destructive measurement. This is the first demonstration of an SEM-based, contact-free, non-destructive technique for high-resolution minority carrier lifetime measurement. The measured values are in excellent agreement with theoretical calculations.

The imaging transport technique is also employed to image the nature of the generation region as a function of beam energy, probe current and sample atomic number. These types of images should be useful to allow for experimental verification of resolution limits in CL and EBIC associated with interaction volume effects in bulk materials and can be obtained without additional sample preparation.

Finally, several suggestions for further research are offered, including mapping of radiation damage in solar cells, near-contact E field mapping and studies of low-dimensional structures such as superlattices and quantum wires. These nanoscale structures are poised to usher-in the next revolution in solid-state electronic devices.

KEYWORDS: Contact-Less Measurements, Diffusion, Drift, Semiconductors, Transport Imaging, Minority Carrier Mobility, Minority Carrier Lifetime, Generation Volume

SPACE SYSTEMS OPERATIONS

ARMY SPACE AND TRANSFORMATION
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Second Reader: LtCol Lawrence E. Halbach, USAF, Space Systems Academic Group

This thesis addresses why the Army is involved in space from historical, doctrinal and policy perspectives. After looking at the current Army space force structure, space missions and Army Transformation, the inclusion of space forces in this Transformation process is detailed. The key takeaway is to understand the units that are emerging from the Transformation process and to know how Army space elements are designed to support them. Current and planned Army Space force structure and the tasks and capabilities they are expected to provide are explained. A key issue is to identify at what level and to what strength space elements should be embedded in the Objective Force organizations. Details on the trade-offs and differences between the Army Space Support Teams (ARSST) at the 1st Space Battalion and the Division-organic Space Support Elements (SSE) are presented. The FA40 (Space Operations) career field is a relatively new personnel category and the development and proper distribution of the FA40 personnel pool is a critical part of assuring success of the FA40 career field, as well as the success of Army and Joint Space Operations. Recommendations are presented on how the Army can reorganize its force structure, allocate personnel and develop future space capabilities requirements documents to ensure relevancy in a transformed Army.

KEYWORDS: Space Support Element, Army Space Support Team, Unit of Employment, Unit of Action, Army Transformation, Functional Area 40, Space Operations Officer, United States Army Space and Missile Command, USASMDC, United States Army Strategic Command, ARSTRAT, United States Strategic Command, USSTRATCOM

ORBIT DETERMINATION OF HIGHLY ECCENTRIC ORBITS USING A RAVEN TELESCOPE
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For the past eight years, the small automated telescope Raven has been tested in detecting and tracking deep space objects. As the Raven has proven successful in tracking this regular and predictable orbit, its one arc-second accuracy makes it a perfect candidate to attempt to accurately track the less predictable Highly Eccentric Orbit (HEO) objects. Ranging data is obtained from the Sirius satellite radio company for the Sirius3 satellite (Satellite Control Center (SCC) # 26626). This satellite is chosen for its long dwell time over the United States and for its favorable Raven tracking conditions. Angles-only data obtained from another Raven telescope located at the AMOS Remote Maui Experiment (RME) facility is used to track the satellite of interest. Then, the Analytical Graphics, Inc. Satellite Tool Kit Orbit Determination (STK/OD) program is used to compare the accuracy of the orbit prediction using ranging tracking data from Sirius and angles-only tracking data from Raven. This paper shows the improvement in orbit determination uncertainty obtained by adding Raven observations to the ranging data. The Raven angles data improves the orbit plane uncertainty and eccentricity estimate differences by over 80% when used with the range observations.

KEYWORDS: Raven Telescope, Highly Eccentric Orbits, Orbit Determination, Sirius Satellite, Satellite Tool Kit, Observations

MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING

ORBIT SELECTION AND EXO-ATMOSPHERIC KILL VEHICLE (EKV) GUIDANCE FOR
SPACE-BASED INTERCONTINENTAL BALLISTIC MISSILE (ICBM) INTERCEPT
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Boost-phase intercept of a threat intercontinental ballistic missile (ICBM) is the first layer of a multi-layer defense. This thesis investigates the requirements and limitations of the U.S. space-based ICBM defense against North Korea, Iran and China by introducing an ICBM trajectory prediction, selecting an orbit for exo-atmospheric kill vehicles (EKV) and developing a hybrid guidance algorithm. The prediction of the ICBM trajectory takes the rotation of the earth and the atmospheric drag into account along with the gravitational forces and thrust. The threat ICBM locations, specifications and capabilities of the EKV and EKV carrier, and the capabilities of the space launch vehicle are analyzed to determine an appropriate orbit for the space-based intercept. The pursuit guidance, proportional navigation guidance and bang-bang guidance rules and their performances are investigated and simulated for three example ICBM threats in three-dimensional environment. The simulation results performances are compared and analyzed for minimum miss distance, intercept time and total command effort. The guidance rules are combined to meet the mission requirements, resulting in a hybrid guidance algorithm, which uses different guidance rules for different stages of a boost-phase intercept scenario.

KEYWORDS: Spaced-Based Missile Defense, Boost-Phase Missile Defense, Trajectory Prediction, Space Launch Vehicle, Orbit Selection, Kill Vehicle, Intercept Geometry, Proportional Navigation, Pursuit Guidance, Beam Rider, Bang-Bang Guidance

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SCATTERING FROM MULTI-LAYERED METAMATERIALS USING WAVE MATRICES
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The complex permittivity (ε) and permeability (μ) of a material determine the response of the material to electromagnetic radiation. Usually, the real parts of ε and μ are positive for naturally occurring materials at microwave frequencies. Metamaterials are engineered media designed to have either a negative permittivity or permeability or both. Negative permeability and negative permittivity would cause electromagnetic waves traveling through this medium to exhibit unusual characteristics such as power flow in a direction opposite to the phase velocity. In this thesis, the wave matrix approach is used to calculate the total reflection and transmission coefficients of a multilayered structure. The method is applicable to all types of materials, including metamaterials. Several layered configurations are studied, including both metamaterial and conventional dielectric layers. A MATLAB program is developed to examine the effects of frequency, angle of incidence and polarization. Results are compared to published data. Potential applications of metamaterials are also discussed.

KEYWORDS: Complex Permittivity and Permeability, Negative Index, Metamaterials

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SYSTEMS ENGINEERING

DATA SET SIMULATION AND RF PATH MODELING OF A QPSK RADIO COMMUNICATION SYSTEM
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This thesis simulates quadrature phase-shift keying (QPSK) modulation signals and uses a laboratory environment to create deteriorating effects of real-world high frequency (HF) transmissions that may modify the ideal QPSK waveform. These modifications may be identifiable in order to "fingerprint" the source of the modifications. To simulate the transmission path in the real world, a signal generator is used to create the QPSK I/Q signal at the HF operating frequencies and a digital sampling oscilloscope acts as a receiver and records the data for analysis. A computer with the MATLAB instrument-control toolbox is used to generate a random-input data stream as an input to the signal generator, which modulates the RF signal. The RF signal chosen is HF (5-15 MHz) and the QPSK modulation is at 9600 baud. The deterioration effects of a real world transmitter site are chosen to be associated with the output amplifier linearity and with the transmission line condition between the transmitter and antenna.

KEYWORDS: QPSK, Modulation, Deteriorating Effects, Transmission Path, Fingerprint, I/Q Signal, HF, RF Signal

PERFORMANCE ANALYSIS OF IEEE 802.11G SIGNALS UNDER DIFFERENT OPERATIONAL ENVIRONMENTS
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A modern military environment requires flexible, capable and robust communications systems. Wireless communications infrastructures can provide all these services, which are absolutely necessary to soldiers on the battlefield or to mission planners. The IEEE 802.11g wireless local area network (LAN) seems to fit the military's needs since it can provide data rates up to 54 Mbps and it is backward compatible with the earlier 802.11b specification.

The purpose of this thesis is to implement, analyze and evaluate the performance of an outdoor point-to-point 802.11g WLAN under different operational environments. Implementation is achieved using two low-cost commercially available wireless bridges and directional external antennas from a well-known manufacturer, Cisco. As part of the analysis, the effective throughput of this standard, the packet error rate and the received signal strength, are measured in each of the following three environments: suburban area, medium density vegetation and coastal. The signal path loss is then calculated from the recorded results and is compared to theoretical results from common outdoor propagation models. A new path loss exponent, n, is also estimated for each case. Based on this exponent, the free space path loss model is properly modified in order to fit the measured path loss results.

KEYWORDS: IEEE 802.11g, Wireless LAN, Data Throughput, Path Loss Exponent

SYSTEMS ENGINEERING

ANALYSIS AND COMPARISON OF DODAF AND ZACHMAN FRAMEWORK FOR USE AS THE ARCHITECTURE FOR THE UNITED STATES COAST GUARD'S MARITIME PATROL COASTAL (WPC)

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Northrop Grumman Ship Systems was recently awarded the Coast Guard Deepwater project to produce three classes of ships: the Maritime Security Cutter, Large and Medium (WMSL and WMSM) and Maritime Patrol Coastal (WPC). The System Architecture Description Document (SADD), which describes the architectural framework used to establish the rules, guidance and product descriptions for developing and presenting architecture descriptions that ensure a common denominator for understanding, comparing and integrating architectures, needs to be written for the WPC. The SADD has been written, established and contractually agreed upon for both the Large and Medium Cutters. However, their missions dictate that they have littoral capabilities and the capacity to conduct missions with naval vessels; therefore, the C4ISR architecture was chosen for their SADD as it fits their mission statements. The mission of the WPC is of a different nature. It is not expected to carry out the same functions as the larger cutters and its capabilities will be more of a littoral function. Therefore, the application of its architectural framework will enable architectures to contribute most effectively to building an interoperable and cost effective system subject to the needs of the WPC mission.

This thesis proposes to compare two different architectural frameworks for use by the WPC's SADD: the Department of Defense (DoD) Architecture Framework and the Zachman Architecture Framework. The thesis compares and recommends the architectural framework that will most enhance the mission statement set forth by the Original Requirements Document (ORD) of the WPC.

EXAMINATION OF THE TECHNICAL AND CULTURAL EFFECT OF THE EVOLVING SERVICE CONTRACTING MODELS ON GOVERNMENT AND INDUSTRY

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This thesis researches the provision of contractor technical support services for the architecture, integration, acquisition and support of integrated and interoperable information solutions to support the national defense and the delivery of specific systems. The support services required by the government are in the functional areas of program management, systems engineering, logistics, installations, and test and evaluation. These functions enable the government to effectively and efficiently fulfill its mission.

The current transition to Performance Based Service Acquisition (PBSA) and Multiple Award Contracts (MACs) has profound impact on program offices, and many organizations are venturing concurrently into these strategies for the first time. The intent of PBSA is "…to maximize performance, innovation and competition – often at a savings." MACs are intended to benefit government and industry by helping to ensure healthy competition and fair and reasonable contract prices.

This thesis examines the impact of PBSA and MAC contracting strategies on the government program offices, along with the inherent cultural effects on both government and industry.

KEYWORDS: Performance Based Service Acquisition, Multiple Award Contracts, Contractor Technical Support Services

SYSTEMS ENGINEERING

AERIAL COMMAND AND CONTROL UTILIZING WIRELESS MESHED NETWORKS IN SUPPORT OF JOINT TACTICAL COALITION OPERATIONS

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This thesis explores the ability of wi-fi technology and the Institute of Electrical and Electronic Engineers (IEEE) 802.11 capability to disseminate various forms of information through densely vegetated, high humidity and high temperature environments. Using a lighter-than-air vehicle (balloon) and existing commercial, off-the-shelf (COTS) 802.11b and 802.16 wireless components, real-time information can be brought to the warfighter.

In particular, this thesis experiments with the use of commercially available wireless equipment and various antennae, all attached to a helium-filled balloon to send and receive video, audio and digital information. This information is then disbursed to individual members of an established network over a specified land-mass. The balloon plays an important role in connecting network members to information that helps local and national commanders in making tactical decisions. These decisions consist of deploying forces, identifying and targeting the adversary, and deterring hostilities, and identifying the best method to supply real-time data to facilitate the movement of military assets and enhance a military's ability to engage an enemy decisively.

Employing COTS systems to disseminate real-time information is a potentially inexpensive solution to enable air and ground components to survey and target adversaries instantaneously. The ability to provide actionable information to the soldier serves as a force multiplier and increases the probability of mission success.

KEYWORDS: Wi-Fi, Mesh Networks, Surveillance and Targeting, 2.4 GHz Antennae, Signal Propagation, Breadcrumb, 802.11b, 802.16, Balloons, Coalition Operating Area Surveillance and Targeting System, COASTS

MARITIME MILITARY DECISION MAKING IN ENVIRONMENTS OF EXTREME INFORMATION AMBIGUITY: AN INITIAL EXPLORATION

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This thesis examines the following hypothesis: through the combined use of common training and collaborative planning, a decision maker may sufficiently alleviate the harmful effects of an environment of extreme information ambiguity so that he/she can continue to make effective decisions. An environment of extreme information ambiguity, a dependent variable, is one of the most difficult components of a battle, where the decision maker may reach a confusing and debilitating point where surviving seems less and less likely. Common training, an independent variable, purports that everyone who is relevant to the situation in the battlespace has similar skills, education, doctrine and standards of performance, coupled with comparable experiences. Collaborative planning, also an independent variable, connotes a sharing of ideas, synchronization of assets, use of information technology, global real-time mission planning, face-to-face meetings and other information sharing techniques for situations of collective concern.

This thesis is a unique and in-depth exploration of the relation of these three variables. Until now, no other research has looked at the relation of common training and collaborative planning with respect to decision making in environments of extreme information ambiguity. In order to explore the model, the researcher analyzes two historical military battles: the Battle of Trafalgar and the Battle of Midway. Detailed research using a case study method is conducted to determine if the battles substantiated the thesis model. Research results indicate that for the maritime battles studied, the model appears to be a useful tool for interpretation and description of events and their outcomes. However, future studies should also

increase the number and type of battles studied. Other independent variables, such as time and leadership, should also be considered.

KEYWORDS: Information Ambiguity, Common Training, Collaborative Planning, Collaboration, Time, Leadership, Fog of War, Time Pressure, Delayed Action-Feedback Loop, High Stakes, Senses, Cognition, Decision Maker, Cognitive Tunnel Vision, Affect, Similar Training, Vigorous Training, Mission Oriented Command, Auftragstaktik, Moltke, Similar Skills, Alignment, Sharing Ideas, Synchronization of Assets, Global Real-Time Tactical Mission Planning, Face-to-Face Meetings, Shared Situational Awareness, Information Flows, Issues Raised, Brainstorming

RETURN ON INVESTMENT ANALYSIS OF INFORMATION WARFARE SYSTEMS
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The United States Navy's Cryptologic Carry-On (CCOP) program office manages a portfolio of information warfare (IW) systems. This research and case study demonstrate how the knowledge value added (KVA) methodology can be used to formulate a framework for extracting and analyzing performance parameters and measures of effectiveness for each system. KVA measures the effectiveness and efficiency of CCOP systems and the impact they have on the intelligence-collection process (ICP) onboard U.S. Navy ships. By analyzing the outputs of the subprocesses involved in the ICP in common units of change, a price per unit of output can be generated to allocate both cost and revenue at the subprocess level. With this level of financial detail, a return on investment (ROI) analysis can be conducted for each process or asset.

KEYWORDS: ROI, Return on Investment, ROA, Return on Asset, IT ROI, IT Performance, IT Valuation, KVA, Knowledge Value Added, Public Sector Finance, Knowledge Asset Valuation

DEVELOPMENT OF A WEATHER RADAR SIGNAL SIMULATOR TO EXAMINE SAMPLING RATES AND SCANNING SCHEMES
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A weather radar signal simulator that produces an output consisting of a vector of I and Q values representing the radar return permits investigation of the performance of different estimators for the weather signal parameters and their sensitivity when varying radar parameters and precipitation models. Although several empirical statistical models are available to describe precipitation behavior, the creation of a physical model enables adaptation to actual data (e.g., rain rate, wind shears) thereby making it possible to apply and examine different scanning schemes, especially rapid scanning schemes. A physical model allows gradual improvements to realism to study the effects on the radar return for different phenomena. A Weather Radar Signal Simulator is developed in MATLAB. Several different functionalities are implemented, allowing for stepped frequency, multiple pulse-repetition frequencies (PRFs), pulse compression using a chirp and variation of both weather and radar input parameters. Post processing capabilities include autocorrelation and fast Fourier transformation (FFT, for single PRF only); estimation of weather parameters, such as reflectivity factor Z; average doppler, radial velocity and velocity spread; pedagogical plots including a Phasor plot of phase change over time and a velocity histogram, instantaneous observed reflectivity and power for each pulse over time.

KEYWORDS: Weather Radar Signal Simulator

SYSTEMS ENGINEERING

**FREQUENCY AND POLARIZATION DIVERSITY JAMMING OF COMMUNICATIONS
IN URBAN ENVIRONMENTS**
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In this thesis, two approaches to investigate how to exploit frequency and polarization techniques in reducing the effects of jamming against unmanned aerial vehicle (UAV) relay communication links in an urban warfare environment are presented. They are polarization diversity and frequency diversity. Even though there is no dramatic difference between the two polarization types, a vertically polarized transmitter has higher percentages of links that could be established for every location taken on the flight path. The highest percentage obtained is 94% for vertical polarization and 93.1% for horizontal polarization. However, there may be some real life scenarios where varying antenna polarization can provide more reliable links. Lower frequencies have better performance compared to higher frequencies. High frequencies are more attenuated in lossy materials like concrete, which is used for the buildings in this study. Furthermore, the path loss increases with frequency. This decreases the received power because the antenna gains are assumed constant (i.e., half-wave dipoles). The percentage of good links is at the highest level of 93.7% for the center frequency of 0.9 GHz. It is reduced to 91.6% at 2.4 GHz and it reaches a low of 89.7% at the center frequency of 5 GHz. However, higher frequencies may be preferred since they have an advantage of higher data rates compared to lower frequency bands. There is a tradeoff in this regard. A final point to note is that even though the ground jammer is not all that effective, it could concentrate its energy on the UAV receiver and probably be more disruptive. Although two-way links would be interrupted, the downlink portion would still function. The UAV transmitter could still send information and commands one-way to ground troops without interruption.

KEYWORDS: Unmanned Aerial Vehicles Relay, Communication Jamming, Urban Propagation, Urbana Wireless Toolset, Antennas in Communication Systems

**FULL-SPECTRUM INFORMATION OPERATIONS AND THE INFORMATION-
PROFESSIONAL OFFICER INTERMEDIATE-QUALIFICATION PROCESS: FILLING THE
GAP TO ENSURE THE CONTINUED LEADERSHIP OF THE INFORMATION-
PROFESSIONAL COMMUNITY IN THE AREA OF INFORMATION DOMINANCE**
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There currently exists a major effort within the United States Navy's Information Professional (IP) Community to overhaul and improve the qualification process for its officers. The overall effort has included the addition of technical refresher courses, re-examination of the Continuing Education Units (CEU) system and improvement of the Basic, Intermediate, and Advanced Qualification programs. This thesis specifically addresses the Intermediate Qualification (IQ) and the lack of Information Operations (IO) concepts therein. While some portions of the IQ that address highly technical areas exist, there is little to no mention of the importance of and concepts contained within IO, as defined by Joint Doctrine.

The IP Community has a unique opportunity to train its officers in the concepts, competencies and supporting activities of IO. This will ensure that the IP Community continues to be the Navy's leaders in the area of information dominance. This thesis provides recommended line items for injection into the IP IQ in the appropriate format, with discussions and definitions that address the specific line items. The thesis also provides further recommendations for the continuing improvement and refinement of the IP qualification process, especially in the area of IO.

SYSTEMS ENGINEERING

MODEL TO CALCULATE THE EFFECTIVENESS OF AN AIRBORNE JAMMER ON ANALOG COMMUNICATIONS

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The objective of this study is to develop a statistical model to calculate the effectiveness of an airborne jammer on analog communication and broadcast receivers, such as AM and FM broadcast radio and television receivers.

During the development, the required power margin in dB, or equivalently, the required linear ratio, between the jammer power and the carrier power at the target receiver input is first determined. Subsequently, using probabilities that the jammer power will exceed the target signal's carrier power, the required power margin is calculated.

This power margin is determined by statistical techniques to predict the propagation characteristics of communication and broadcast signals, such as Log-Normal Shadowing, and Small-Scale Fading.

From the model, it is determined that it is difficult to achieve high probabilities of exceeding the required jamming margins with a single jammer. Hence, the use of spatial diversity jamming is recommended, that is, using two or more jammers spaced sufficiently far apart from each other, such that their jamming signals at the targeted area are de-correlated due to the differences in their respective angles of arrival.

SIMULATION AND EVALUATION OF ROUTING PROTOCOLS FOR MOBILE AD HOC NETWORKS (MANETS)

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Mobile Ad hoc networks (MANETs) are of much interest to both the research community and the military because of the potential to establish a communication network in any situation that involves emergencies. Examples are search-and-rescue operations, military deployment in hostile environment and several types of police operations.

One critical open issue is how to route messages considering the characteristics of these networks. The nodes act as routers in an environment without a fixed infrastructure, the nodes are mobile, the wireless medium has its own limitations compared to wired networks and existing routing protocols cannot be employed without modifications.

Over the last few years, a number of routing protocols have been proposed and enhanced to solve routing in MANETs. It is not clear how those different protocols perform under different environments. One protocol may be the best in one network configuration but the worst in another. This thesis describes a study of those protocols that are best from a Department of Defense (DoD) perspective. These wireless

mobile networks are simulated under different mobility and traffic scenarios to evaluate their performance. Results show which protocols performed better under several relevant scenarios and expose a number of design flaws.

KEYWORDS: Mobile Ad Hoc Wireless Networks, Routing Protocols, Network Simulator, NS2, Mobility Models

MASTER OF SCIENCE IN SYSTEMS ENGINEERING MANAGEMENT

LESSONS LEARNED FROM AN AFLOAT INSTALLATION OF AN ASHORE COMMAND AND CONTROL SYSTEM

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The installation process for afloat systems is very stringent. This rigor is necessary to ensure that warfighters can fully utilize the functionality provided by information technology (IT) aboard a ship, especially when underway - removed from most technical support and assistance. However, this rigor also increases the difficulty of executing an afloat installation. The purpose of this thesis is to document the lessons learned from the installation of the Ocean Surveillance Information System (OSIS) Evolutionary Development (OED) onboard the *USS BLUE RIDGE* (LCC-19). OED is an ashore multi-level secure (MLS) command and control and intelligence (C2I) computer system that is fielded at the Joint Intelligence Centers and Joint Analysis Centers. The MLS aspect of OED allows the operator to view and add value to data from multiple security domains on one workstation. In the space, weight and power (SWAP) constrained environment of a ship, this technology is very advantageous. Since OED is an ashore system, this afloat installation presents a number of challenges and a unique perspective into the installation process. This thesis documents these challenges, details how they were overcome and provides recommendations for future installers to improve the planning of future afloat installations.

KEYWORDS: Multi-Level Secure, MLS, Command and Control and Intelligence, C2I, Ocean Surveillance Information System, OSIS, Evolutionary Development, OED, Fleet Modernization Program, FMP, Temporary Alteration, TEMPALT

MEASURING CUSTOMER AND EMPLOYEE LOYALTY AT SPACE AND NAVAL WARFARE SYSTEMS CENTER CHARLESTON

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As a Navy working-capital fund (NWCF) activity, Space and Naval Warfare (SPAWAR) Systems Center, Charleston is faced with many unique and challenging business prospects. As a government activity with government employees, SPAWAR Charleston is uniquely aligned and charged by Congress to support the objectives and needs of its government customers. An NWCF activity is also a non-appropriated government entity that must rely, as any commercial sector business, on continued funding streams on a year to year basis. Unlike a commercial entity, however, there are strict legal limits to how and what kinds of work SPAWAR Charleston can acquire and perform.

Given these unique circumstances, it is difficult to directly fit commercial management and measurement practices to SPAWAR Charleston or to many other Department of Defense activities. As

SPAWAR Charleston continues to grow and expand its business base, it must be able to provide outstanding value to its customers while fulfilling its fiduciary responsibilities to the taxpayers. New ways must be found to quantify, measure and take action on similar but different business factors than those used in the traditional commercial sector. This research focuses on the adaptation of commercial customer and employee loyalty measurement to an NWCF activity.

KEYWORDS: Navy Working Capital Fund, NWCF, Customer Loyalty, Employee Loyalty, Customer Satisfaction

SIMULATION OF WIRELESS PROPAGATION AND JAMMING IN A HIGH-RISE BUILDING
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Wireless local area networks (WLANs) extend the usage of wired LANs from specific places within a building to many mobile users, whether in the building or outside. The wireless data is not only used by authorized users, but also might be intercepted and altered by other unauthorized users. Therefore, the power of the transmitter is kept as low as possible to make it difficult for others to intercept the signal. In the absence of interception, adversaries might attempt to jam the signal so that the network cannot operate properly. The purpose of this study is to investigate the effects of noise jamming against a WLAN in a high-rise building.

The building model is created by Rhino, a well known Windows-based computer drawing software. The jamming effects are simulated using Urbana. The LAN transmitter operates with an omni-directional antenna and 100 mW of power. The noise jammer has variable power levels of 10 W and 100 W. It uses a directional antenna. The signal-to jam-ratio (SJR) is computed for several floors in the building to determine if the jammer will disrupt the WLAN.

KEYWORDS: Urbana, Simulation of Wireless Propagation, Indoor Propagation, Antenna Fundamentals, Radio Wave Propagation, Wireless Networks, WLAN Security, Communication Jamming, Signal to Jam Ratio, SJR

MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY

ANALYSIS OF BINARY EXTENSIBLE MARKUP LANGUAGE (XML) SUITABILITY FOR NATO TACTICAL MESSAGING
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The ability to efficiently transfer information among tactical systems is essential for network-centric operations. However, maintaining interoperability among heterogeneous networks and applications is a challenging issue, especially for large enterprises such as the U.S. Department of Defense and NATO. Each of these organizations maintains extensive communication networks of tactical systems that process and manage all types of data. Additional complexity is added when considering that many systems are built with a variety of proprietary or legacy data formats. Establishing and maintaining interoperability is difficult.

Using Extensible Markup Language (XML), many interoperability issues can now be successfully addressed. XML provides a self-describing way to effectively structure information that can be applied to compose diverse tactical communications. However, XML is inefficient for network transmission since it uses a text-based format that can consume more memory (and thus more bandwidth) than binary equivalents. In addition, parsing text-based documents is slow and computationally expensive. One potential solution is to use GZIP to reduce the file size before transmission. Unfortunately, this solution has limitations since it often provides suboptimal compression and also requires additional processing time when extracting data. Recent standardization efforts have identified promising new encodings for XML that use binary representations to reduce parsing time, memory size and bandwidth requirements.

This thesis surveys the conversion of NATO tactical data link information into an XML format for distribution to command and control centers. General benefits and tradeoffs are then considered for applying binary XML encoding to that data. This thesis also examines work done by the World Wide Web Consortium in examining common use cases and developing the requirements needed for binary XML encoding. The performance of two specific implementations, XML Schema-based Binary Compression (XSBC) and Fast Infoset (FI) are compared with GZIP. XML files of varying sizes are encoded in binary form, then compression ratios and parsing times are compared and analyzed. Initial results are excellent and further work is recommended.

KEYWORDS: XML Schema Based Compression, XSBC, Extensible Mark-up Language, XML, Tactical Data Links, Binary XML, Fast Infoset

SYSTEMS TECHNOLOGY

**GLOBAL POSITIONING SYSTEM (GPS) EPHEMERIS MESSAGE
BROADCAST SIMULATION**
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The warfighter constantly needs increased accuracy from a global positioning system (GPS). One means of increasing this accuracy to the decimeter level is a broadcast an ephemeris message containing GPS satellite orbit and clock corrections. The ephemeris message is produced at the GPS MCS (master control station), which receives GPS signal data from the National Geospatial Intelligence Agency (NGA) and Air Force worldwide, and uses sophisticated software to produce the orbit and clock corrections

The problem is getting the ephemeris message to the tactical user in a forward operating area. This thesis proposes a notional architecture for pushing the ephemeris message to the tactical user. It then models the architecture and simulates the broadcast of the ephemeris message to a tactical user using network warfare simulation (NETWARS). The baseline architecture is simulated and analyzed and then additional constraints are placed upon the network to simulate a real-world model. The simulation results demonstrate that the architecture is feasible for ephemeris message broadcast with the constraints on time intervals between broadcasts, residual traffic and message size.

KEYWORDS: GPS, Differential GPS, GBS, Link 16, Tactical Data Networks, NETWARS, Modeling and Simulation

**COMPARISON OF "FUNCTIONAL CONCEPT OF BATTLESPACE AWARENESS" VERSUS
THE CONCEPT OF "POWER TO THE EDGE," WITH A FOCUS ON INTEGRATING
SHOTSPOTTER SENSORS AND UNMANNED AERIAL VEHICLES**
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Current military doctrine is primarily hierarchical in nature with respect to power and authority. The "Functional Concept of Battlespace Awareness" (FCBA) is a military sensor methodology that employs a hierarchical command structure to test emerging technologies. Asymmetric warfare, however, demands a faster and more adaptive warfighting mentality that distributes power and responsibility across more of our forces; particularly those that are at the frontlines of the battlefield. "Power to the Edge" is a warfighting methodology that emphasizes a departure from traditional military hierarchies and a transition into a configuration that empowers "Edge" actors with information and authority. This thesis proves that "Power to the Edge" doctrine is a more effective way to fight the enemies the U.S. will likely face in the Information Age. By analyzing and interpreting data collected at the Extended Awareness II and Extended Awareness IIB experiments, this thesis shows that transition in current command and control methodology will be necessary to keep up with a changing enemy.

KEYWORDS: Functional Concept for Battlespace Awareness, Power to the Edge, Extended Awareness, Shotspotter

SYSTEMS TECHNOLOGY

**THE BENEFIT OF 802.20 TECHNOLOGIES ON INFORMATION FLOW
IN NETWORK-CENTRIC WARFARE
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This thesis focuses on the area of 802.20 wireless networking and how this technology will vastly benefit U.S. military forces, especially in the network-centric concept of operations, where information flow is crucial. This technology is investigated using published literature and previously gathered experimental data. Findings are related to network-centric warfare and the matters that could be most affected by this new technology.

KEYWORDS: Network Centric Warfare, 802.20, Wireless Networking, Command and Control

**FROM STICKS AND STONES TO ZEROS AND ONES: THE DEVELOPMENT OF COMPUTER
NETWORK OPERATIONS AS AN ELEMENT OF WARFARE - A STUDY OF THE
PALESTINIAN-ISRAELI CYBERCONFLICT AND WHAT THE UNITED STATES
CAN LEARN FROM THE "INTERFADA"
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The Palestinian-Israeli Cyberconflict erupted in 2000, when Israeli hackers crippled the prime website of Hezbollah by mobilizing pro-Israeli supporters to "bomb" the site with automated floods of electronic mail. In retaliation, Hezbollah rallied pro-Arab supporters for a counter-attack, which soon downed the main Israeli government website and the Israeli Foreign Ministry site. Attacks involving website defacements, denial-of-service, viruses and Trojan horses were waged by both parties for a span of months, effectively shutting down websites, disrupting Internet service and e-commerce. As is evident by this turn of events, one need search no further than a computer savvy teenager and his laptop for an effective weapon of choice against an adversary's economy, infrastructure, military or government. Additionally, psychological operations, to include deception and propaganda, continue to influence one's enemies, and at times the world audience, into acting in a manner conducive to one's aims. In effect, the asymmetric element of information warfare may eventually level the battlefield between superpowers and minor states and/or terrorist organizations.

A study and analysis of the utilization and effects of computer network operations (CNO) between pro-Israeli and pro-Palestinian actors during the al-Aqsa Intifada may highlight current trends in warfare, support the notion that information may level the battlefield and provide the United States with the means to better protect itself against such attacks in the future.

This thesis collects, classifies, analyzes, defines and resolves information operations/information warfare (IO/IW) activities, specifically focused on the utilization and effects of CNO during the Al-Aqsa Intifada, and how such analysis can be applied to United States national security. Through analysis of the utilization and effects of IO/IW during the Al-Aqsa Intifada, the United States may be better able to prevent such attacks against its own networks and sources of information and infrastructure.

KEYWORDS: Information Warfare, Information Operations, Computer Network Operations, Palestinian-Israeli Cyberconflict, "Interfada"

MASTER OF ARTS

Homeland Security Affairs
National Security Affairs
Security Studies

MASTER OF ARTS
IN
HOMELAND SECURITY AFFAIRS

**PREPARING MILITARY OFFICERS FOR EFFECTIVE SERVICE
IN AN INTER-AGENCY ENVIRONMENT**
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This thesis evaluates, through the lens of the 1986 Goldwater-Nichols Act, training and assignment policy alternatives for expediting the development and deployment of military officers to fill billets requiring inter-agency expertise. Using United States Northern Command as a case study, these policy alternatives are examined and Joint Mission Essential Tasks are proposed that might form the basis for required training and education. The thesis proposes the establishment of a Homeland Defense College and suggests that military officers be awarded credit for joint tours through service with non-Department of Defense (DoD) agencies. The thesis argues that uniformed service resistance to expanded DoD/inter-agency engagement should be anticipated. Mitigating measures are suggested based extensively upon a conceptual framework for successful military innovation developed by Terry C. Pierce.

KEYWORDS: Goldwater-Nichols Act, Homeland Defense, Homeland Security, USNORTHCOM, Joint Mission Essential Task List, Universal Joint Task List, DoD/Inter-agency Collaboration, Department of Defense

MASTER OF ARTS
IN
NATIONAL SECURITY AFFAIRS

CONVERGENCE ON COOPERATION: THE DRIVING FACTORS IN U.S. AND RUSSIAN COOPERATION ON BELARUS
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As the last dictatorship in Europe, Belarus is a "problem state" for the United States. This thesis analyzes U.S. interests in Belarus and assesses the extent of the interdependence of these interests with Russian interests in the country. It first establishes a theoretical framework for U.S. and Russian national interests and the possibility of cooperation between the two countries. It then examines the mutuality of U.S. and Russian interests in Belarus in the areas of democracy and human rights, drug and human trafficking, arms proliferation, oil and gas transit and Russo-Belarusian trade and political integration. Policy options available to each country are also examined. Other elements of cooperation are applied to the situation in Belarus. Finally, the possibilities for cooperation are evaluated.

This thesis demonstrates that the achievement of U.S. interests is significantly constrained by Russia's willingness to cooperate and that the United States can best achieve its objectives only through cooperation with Russia. This cooperation should center on neither country's first preference, but a compromise solution involving the ascendance of a moderate opponent to Lukashenka from within the Belarusian elite.

KEYWORDS: Russia, Belarus, Oil Pipelines, Democratic Revolution

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DISMANTLING THE AFGHAN OPIATE ECONOMY: A CULTURAL AND HISTORICAL POLICY ASSESSMENT, WITH POLICY RECOMMENDATIONS
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This thesis applies lessons drawn from a historical-cultural analysis of rural power structures in Afghanistan to understand the nature of the threat posed by that country's opiate economy and to assess the counter-narcotics policies of the United Kingdom and the government(s) of Afghanistan and the United States. It argues that the opiate economy should be considered an Afghan-specific problem involving narcotics, not a "drug war" problem involving Afghanistan. Specific lessons are taken from a chapter dedicated to Afghan culture, history and rural power structures, and applied in chapters analyzing the opiate economy and current counter-narcotics policies. Several insights critical to sound policy and not found in existing literature are developed. Overall, the current policy emphasis on aggressive eradication of opium poppy is incongruent with local cultural and political realities, and undermines central government stability. Counter-narcotics policy makers should adopt a rollback strategy, eliminating cultivation from minor-cultivation provinces first for democratic-governance, cultural and counter-narcotics reasons. Counter-trafficking should be prioritized over eradication efforts and should particularly target anti-government forces, many of which are legacy groups of the anti-Soviet jihad and are not accountable to or culturally integral to rural society.

KEYWORDS: Afghanistan, Counter-Narcotics, Culture, Drugs, Eradication, Heroin, Karzai, Narcotics, Opium, Opium Economy, Pashtunwali, Qawm, Stabilization, Trafficking

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WHY CULTURE MATTERS: AN EMPIRICALLY-BASED
PRE-DEPLOYMENT TRAINING PROGRAM

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As part of analyzing any dynamic situation or area in military operations, it is crucial to addresses how and why culture matters to the military. This thesis utilizes a systems approach for analyzing both the operational environment and culture, recommending an empirically-based pre-deployment training program that trains military members to operate at the higher level of effectiveness required for stability operations and today's "strategic sergeant" informational environment. A systems approach to analyzing the operational environment considers the current situation and the military mission in the context of geographic, societal, political, economic, military, paramilitary, security and historical dynamics. This approach also analyzes culture through cross-cultural communications training. In order to align empirical and doctrinal analysis with operational realities, the thesis presents a pre-deployment framework and a tailored template for training at the basic, intermediate and advanced levels. A systems approach towards culture and the operational environment, applied to pre-deployment training and linked with long-term regional educational studies and language proficiency, will improve the military's ability to operate successfully across the range of military missions.

KEYWORDS: Culture, Pre-Deployment Training, Doctrine, Joint Intelligence Preparation of the Battlespace, Joint Intelligence Preparation of the Operational Environment, Operational Environment, Stability Operations, Systems Theory, Military Training

WHY IRAN PROLIFERATES

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Iran and the United States have faced each other across a deep divide ever since the Iranian Revolution of 1979 and the events of the American Embassy hostage crisis. The absence of diplomatic relations between the two nations has led to a lack of communication that has resulted in difficulties crafting successful policies to build bridges between the two governments. The specter of Iran's quest for nuclear weapons casts a further pall on these troubled relations. Case studies of historical examples of nuclear proliferation using multi-causality can shed light on what factors are motivating Iran to seek nuclear weapons. Once these factors are understood, the United States can craft rational policies to pursue its goals in the Middle East while accommodating the probable rise of nuclear industry in Iran.

KEYWORDS: Iran, Nuclear Proliferation, American Policy, Proliferation Theory

COPPER SOLDIERS: FORGING NEW ROLES FOR THE CHILEAN MILITARY

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This thesis explains why Chile maintains military budgets in excess of its threat level. Historically, Chile required a well-funded and capable military due to tense regional relations. However, resolution of border conflicts, equipment acquisitions and superior economic performance reduced Chile's threats during the

1990s. Nonetheless, analysts attribute the continued high military budgets to an authoritarian hangover following General Pinochet's reign (1973-1989).

Pinochet's 1998 arrest and trial diminished the power of the military, calling into question past explanations. The judiciary purged the state of junta era commanders, younger more flexible leadership came to power and the political parties agreed on constitutional reform. Yet, after sweeping constitutional reforms, budgets remained high.

This thesis argues that the government maintained defense budgets in order to further the "normalization" of civil-military relations. The military received high budgets and in turn recognized past human right abuses and pledged subordination. With relations stable, both the civilian elite and the military agreed to reorient the military's mission towards peacekeeping. Peacekeeping reinforces civil-military relations while benefiting each party individually. The civilian elite receive international prestige, furthering their foreign policy goals, while the military's mission and budgets are justified. The stable equilibrium guarantees that Chile will remain a regional leader in peacekeeping for the future.

KEYWORDS: Chile, Peacekeeping, Peacekeeping Operations, PKOs, Pinochet, Civil-Military Reform, Constitutional Reform, 1980 Constitution, Military Budgets

THIRD GENERATION GANGS REVISITED: THE IRAQ INSURGENCY
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The insurgency in Iraq has continued despite the determination of U.S. and Iraqi forces. U.S. counter-insurgent strategy has operated from the premise that the main thrust behind anti-U.S. activities is a combination of Sunnis desiring a return to their former privileged position and tribal collective actors with long-standing grievances fueled by radical Islam. Yet an analysis incorporating insights from gang theory illuminates the diverse, practical and local motivations of those involved in insurgent networks. Gang theory is uniquely suited to illuminate the street-level dynamics that drive insurgent violence. Through this, a more precise picture of the relevant networks and their operative motivations can be drawn, allowing finer tuned policies targeted to the differentiated factors behind non-state violence. Origins of and interactions between the armed groups operating in Iraq are considered for discernable trends in development, paying particular attention to factors consistent with gang models. The gang model is altered for the context of Iraq, and an integrated model is presented that articulates the likely effects of state-insurgent interaction on stability and security there. Recommendations demonstrating the model's relevance for strategic use in other regions are provided.

KEYWORDS: Ansar, Ba'ath, Coalition, Counterinsurgency, Counterterrorism, Gang, Global War on Terror, GWOT, Insurgency, Iraq, Islamist, Mujahideen, Netwar, Non-State Actor, Saddam Hussein, Strategy, Sunni, Third-Generation Gang, Terrorist, Transnational, Tribal, Zarqawi

TURKEY AND THE EUROPEAN UNION (EU): KEMALISM'S EFFECTS
ON THE ROAD TO THE EUROPEAN UNION (EU)
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The thesis evaluates the importance of the Kemalism movements on Turkish society during the establishment of Turkey, while proposing that even today; Kemalism is still the best choice for Turkey. The thesis will assess the significance of Kemalism's effect on the society and the institutions of Turkey identify the state-building process before and after the independence war, and the possible effects of the Kemalism ideology for the acceptance of Turkey as a full-member by the EU. After the collapse of the

Ottoman Empire, Turkey emerged from being referred to as the "sick man of Europe." It was not a smooth process, establishing a new state, instead of the former one. There were many intervening powers, at that time, having many interests in the territory of the Ottoman Empire. After the fall of the Ottoman Empire, secular, modern, Westernized, and with a parliament, the Turkish Republic has survived since the World War I. Turkey adopted Western norms to create the state and its society that was led by Mustafa Kemal. Mustafa Kemal led the society according to his thought, and by so doing, created a new society, a new state, above all, a new nation. The ideology of Kemalism, as a non-stop renovation and modernization process for Turkey, has been a guide for Turks. In accordance with the development processes of Turkey, and modifications of in hopes of becoming a member of the EU, Kemalism has acted and still acts as a light on the way to keeping up with the modern world. In order to raise Turkey's civilization level to that of Western civilizations, NGOs should take the most responsibility to ensure that Kemalism is properly applied.

KEYWORDS: Kemalism, European Union, Contemporary Civilization Level

FIRST RESPONDER READINESS: A SYSTEMS APPROACH TO READINESS ASSESSMENT USING MODEL BASED VULNERABILITY ANALYSIS TECHNIQUES
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Current approaches to readiness tend to focus on quantities of resources and their status. Status reports fall short of providing a probability based forecast of a unit's true potential for mission success. At the local level, municipalities must continually balance public safety priorities with demands for other government services. For most municipalities, a strategy of funding all resource deficiencies is simply not practical from a fiscal standpoint. By using fault and event trees to analyze readiness, it is possible to determine the probability of a unit failing at its assigned mission. This analysis then allows a commander to fund those vulnerabilities, or combinations of vulnerabilities, that increase the probability of mission success.

KEYWORDS: Readiness, Intangible Assets, Tangible Assets, Supplies, Equipment, Personnel, Training, Model Based Vulnerability Analysis, Fault Tree, Event Tree, Sector Vulnerability, Probability, Risk

THE INSTRUMENT-ELEMENT MODEL: A GRAND-STRATEGIC MODEL FOR WAR
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This thesis develops a model for understanding and conducting war at the level of grand strategy. Grand strategy seeks the seamless integration of all aspects of national power to achieve a desired policy goal. The model is named the "Instrument-Element Model" because it focuses on the essential elements that underlie the instruments of power by which belligerents contend with each other.

Each belligerent is modeled by three elements: the people, the government and the military. Belligerents affect each other using the instruments of national power: diplomacy, information, military force, economic leverage and, this thesis argues, ethical principles. This thesis argues that successful grand strategies can focus on the people, the government or the military.

The Instrument-Element Model is tested and illustrated by an analysis of three wars in which a successful grand strategy focused on each of the three elements: the 1967 Arab-Israeli War (focusing on the military), the 1999 Kosovo War (focusing on the government) and the Algerian Revolution (focusing on the people). This thesis also considers how to apply the Instrument-Model to terrorist and insurgent groups, and concludes with three recommendations to help the Republic think, fight and win grand-strategically.

NATIONAL SECURITY AFFAIRS

JAPANESE-U.S. MISSILE DEFENSE: STEPPING STONE TOWARDS NORMALIZATION

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The United States-Japanese missile defense cooperation signals yet another step in Japan's continuing trend of "normalization" and official acknowledgement that Japan has a significant military force. This thesis analyzes the current status of the Japanese missile defense debate and assesses factors shaping the Japanese commitment to joint missile defense with the United States. Three major inter-related trends mark the course of Japanese post-Cold War Self Defense Force (SDF) evolution, relations with the United States and the missile defense debate. These include a willingness to relax legal considerations on the use of military force, the expansion of the roles for the Japan Self Defense Force (JSDF), and the responsiveness of Japanese decision makers to external factors, notably the requirement to improve relations with the United States and the threat perceived from North Korea. This represents a shift to a more military-based security outlook, away from the traditional notion of "comprehensive security." These trends point invariably to the amendment of Article 9 of the Japanese Constitution. To maximize U.S. interests, Washington must pursue a balanced and limited missile defense in East Asia and actively undertake measures to avoid the perception of a threat to Chinese nuclear deterrence.

CHINA'S GREAT GAME IN CENTRAL ASIA: IMPLICATIONS TO U.S. POLICY IN THE REGION

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Over the last decade China has actively pursued its interests in Central Asia. With the collapse of the Soviet Union in 1991, the present countries of Central Asia established independent rule. With Soviet control removed, social and international problems that were hidden and suppressed began to show themselves throughout the region. Seeing the power vacuum, the negative effects of smuggling, separatism and terrorism associated with Islamic fundamentalism, and the effect these issues could have on China, Beijing decided to take steps to help address these concerns in Central Asia.

Currently, the United States is spearheading a war on terrorism, focusing on countries close to Central Asia, such as Afghanistan and Iraq. If the United States plans on staying in the region, it must take into account the forces shaping Chinese foreign policy in Central Asia. Possibilities exist for cooperation, but if the situation is misinterpreted or handled incorrectly, there is also a possibility for conflict. This thesis examines Chinese interests in Central Asia, comparing and contrasting them with U.S. interests in the

region. It then recommends policy options the United States could implement to enable the United States and China to move towards common goals in the region.

KEYWORDS: China, Central Asia, Anti-Terrorism, Foreign Policy, United States, Shanghai Cooperation Organization, Regional Security, Economic Development, Islamic Extremism

CONGRESSIONAL INTELLIGENCE OVERSIGHT: AN EVOLUTION IN PROGRESS 1947-2005
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From the creation of the intelligence community as part of the National Security Act of 1947 to the present day, Congressional oversight has varied depending on popular interest generated by media reports of scandal or due to perceived failures. Conversely, the intelligence community has used the varying degrees of oversight as an opportunity to participate in activities outside its charter. This document examines the evolution of Congressional oversight from virtually non-existent to the current efforts to reform the intelligence community. This study demonstrates that oversight has primarily been driven in response to an abuse or a failure. Popular interest, primarily fueled by media involvement, has forced Congressional action. This is demonstrated by examining the wave of reform after the publication of the Central Intelligence Agency's abuse of power in 1970, again after the revelation of the Iran-Contra affair in 1986 and lastly after the September 11th attacks. The study also uncovers a reoccurrence in the recommended reforms, particularly the recommendation for the creation of a Director of National Intelligence, and the need for greater Congressional involvement.

KEYWORDS: Intelligence, Intelligence Community, Congressional Oversight, Congress, 9/11, 9/11 Commission

U.S. DEMOCRACY PROMOTION AND AL JAZEERA: A VIEW INTO ARAB REACTIONS AND OPPOSING MOVEMENTS
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The promotion of democracy in the Arab world, an area resistant to effective political liberalization to date, has become a central pillar in American Middle East foreign policy, as well as an integral element in the Global War on Terrorism (GWOT). How will this advocacy of democracy be received given our theoretical and historical knowledge? The underlying assumption of U.S. policy is that democracy will moderate some of the anti-American sentiments from the region, as well as undermine terrorist activities and support. Will overt American promotion of democracy cause these states to democratize? Using aspects of social movement theory, this thesis examines Arab reactions to public American promotion of democracy. The author argues that America's campaign is counterproductive because it has polarized the political discourse, a result that weakens potential sources of internal pressure and distorts understandings of democracy, thus facilitating states' maintenance of the status quo. It does this through framing the message as inherently American and spurring opposing movements. Using al-Jazeera data derived from the Foreign Broadcast Information Service (FBIS), connotations associated with each articulation of the word "democracy" are recorded to create a sample of competing frames to observe opposing movement developments and frame contest trends.

KEYWORDS: Middle East, U.S. Foreign Policy, Social Movement Theory, Frame Analysis, Media, Democracy and Democracy Promotion

HOW WILL EXTERNAL POWERS AFFECT KOREAN REUNIFICATION?
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The Korean peninsula has been a focus of contention since the nineteenth century. Following the division of the peninsula after World War II, the issue of when and how Korea will be reunified has been a subject of intense interest, one that has been encouraged of late by the end of the Cold War, the extreme economic weakness of North Korea and the decision by the North to pursue a nuclear option. Although war failed to unify the peninsula in 1950-1953, the fear is that a desperate communist regime may once again attempt to unify the peninsula by force. A second scenario for unification envisions the implosion of an economically debilitated regime in the North. Finally, a peaceful reunification through diplomacy constitutes a third scenario.

The dilemma is that although reunification is intensely desired by the Korean people, the United States, the People's Republic of China (PRC), Japan and Russia prefer a continuation of the status quo. The attitude of Korea's neighbors and strategic partners is important, especially because reunification under whatever scenario will undoubtedly require the support, both diplomatic and economic, of the surrounding powers. This thesis examines the various scenarios for Korean reunification and their implications for international relations in Northeastern Asia. It concludes that the collapse of the political system in the North Korean state will initiate reunification. As a result, China will play the greatest role upon reunification and will therefore have a superior influence over the peninsula.

KEYWORDS: Korea, North Korea, South Korea, Korean Peninsula, Reunification, United States, Russia, China, Japan, Sunshine Policy, Six Party Talks, Beijing Talks, War, Collapse, Diplomatic Reunification, Kim Jong-Il

SHANGHAI COOPERATION ORGANIZATION: PAPER TIGER OR REGIONAL POWERHOUSE?
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Russia, China, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan formed the Shanghai Cooperation Organization (SCO) in 2001. The inclusion of India, Pakistan and Iran in 2005 renewed speculation over a new "Great Game" in Central Asia. While this notion is superficially attractive, this thesis delves deeper into what is driving Russian and Chinese interests in Central Asia, and thus, the SCO.

The results are contradictory. For Russia, participation in the SCO reflects an identity driven interest. Russia views its membership in the SCO as the means by which it regains superpower status. China's participation in the SCO is driven by its energy concerns, as a means to achieve long-term economic security.

Though the American presence in Central Asia after September 11, 2001, has complicated both Russia's and China's pursuit of these interests, the SCO should not be viewed as a defensive alliance against the U.S. Instead, the SCO resembles a dysfunctional international regime created to avert the threat of revolutionary upheaval in Central Asia and to pursue a common interest in long-term economic growth through increased cooperation and collaboration.

KEYWORDS: Shanghai Cooperation Organization, SCO, Shanghai-Five, Central Asia, Sino-Russian Relations, U.S.-Russia Relations, Sino-U.S. Relations, U.S.-Central Asia Relations, "Great Game," Collective Security Treaty Organization, CSTO, Commonwealth of Independent States, CIS

LEVERAGING EMERGING TECHNOLOGIES IN SOUTHERN THAILAND
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Since 2001, the Kingdom of Thailand has seen a resurgence of ethno-religious (Malay-Muslim) violence that has killed approximately 800 people, causing obvious disruption within the nation and instability in the region. As one of the U.S.' staunchest allies in Southeast Asia and with the potential for this violence to intensify further, it behooves the U.S. government to offer solutions to help mitigate or reduce the violence in southern Thailand.

This thesis examines the history of southern Thailand, analyzing the political factors behind the Malay-Muslim rebellions of the past, tracing the roots of their rebellion back to the era of Patani Raya and the "Siamization" of the south. It explores the various trends and actors and other antecedent conditions (external influences) during the recent violence. Information on the various separatist groups operating in southern Thailand is provided, along with an analysis of the porous Thai-Malay border and the role of PAS in southern Thailand. Lastly, this thesis examines a Naval Postgraduate School (NPS) field experimentation program entitled Coalition Operation Area Surveillance and Targeting System (COASTS). COASTS provides tactical, actionable information to remote and local decision-makers by integrating commercial, off-the-shelf (COTS) technologies such as unmanned aerial vehicles (UAVs), lighter than air vehicles (LTA), unattended air and ground sensors and wireless meshed networks technologies. If deployed to problematic areas, systems like COASTS can assist the Royal Thai government in reducing the violence in the south.

KEYWORDS: Insurgency, Counter-Insurgency, Muslim, Militancy, Separatism, Terrorism, Border Defense, Emerging Technology, Pattani, Patani, Yala, Naratiwat, Thailand, UAV, LTA, COASTS

MASTER OF ARTS
IN
SECURITY STUDIES

OPENING THE MEXICAN DOOR: CONTINENTAL DEFENSE COOPERATION
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Today's security environment has changed dramatically and the institutions that defend the continent against common threats must adapt to remain viable. Otherwise, the safety, security and economic prosperity of North America will be in jeopardy. The World Trade Center attack demonstrated that asymmetric threats can approach the U.S. from any direction. This attack also reinforced that natural and technological disasters can have bi-national consequences and continental impact. Given this, a noticeably missing element in the defense relationship with Canada and Mexico is the absence of a formal policy for bilateral military cooperation in support of civil authorities. Also missing is a Mexican defense coordinating presence at the North American Aerospace Defense Command (NORAD) and the United States Northern Command (USNORTHCOM). This thesis examines U.S.-Mexican security challenges and argues that a bilateral, transnational, emergency management framework that incorporates a civil-military partnership can serve as the cornerstone upon which North American defense can be built.

KEYWORDS: Mexican-U.S. Military Relations, Theater Security Cooperation, Military Support to Civil Authority, Strategic Planning

HOMELAND SECURITY AND CAPABILITIES-BASED PLANNING:
IMPROVING NATIONAL PREPAREDNESS
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Beginning in 2004, the Department of Homeland Security (DHS) began to define and implement a national domestic all-hazards preparedness goal, intended to improve the nation's preparedness for national catastrophes, including terrorist attacks. The DHS' approach was capabilities-based planning (CBP), adopted from the Department of Defense (DoD). CPB is intended to develop the means - capabilities - for organizations to set priorities responding to a wide range of potential though uncertain challenges and circumstances, mindful of issues of cost and sustainability. This thesis is intended to help officials better understand CBP and the factors important to its successful implementation. These factors range from setting out the business case for CBP adoption to necessary organizational and cultural enablers. In conclusion, the thesis recommends enhancing the CBP approach to national preparedness planning through integrating its approach with a national preparedness management standard, coverage of the mission areas of the National Strategy for Homeland Security and encouraging performance partnership and collaborative methods.

KEYWORDS: Homeland Security, National Preparedness, Capabilities-Based Planning, Results Management

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**GOVERNMENT ACTIONS IN THE DEMISE OF THE THUGS (1829-1835) AND SIKH
TERRORISTS (1980-1993) AND LESSONS FOR THE UNITED STATES**
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Faced with the very substantial threat of terrorist attack, the United States must ask the question, What actions were taken by other states in the past to successfully combat terrorism? Knowledge of those steps may lead to a greater understanding of what actions are desirable, necessary or simply unavoidable in counterterrorism efforts. Having such understanding is needed to plan policies, strategies and tactics that are effective and acceptable to both citizens and the international community. The history of the successful counterterrorism campaigns against the Thugs (1829-1835) and Sikh terrorists (1980-1993) show a number of commonalities in the actions taken by the governments in power at that time. In both cases, abridgement of civil liberties, as per present day standards in the United States, played a major role in the governments' campaigns. These two cases, as well as other historic cases, lead to the conclusion that following successful terrorist attacks, civil liberties will be curtailed. The United States must expect this curtailment and should take actions to ensure that these actions are temporary, warranted and effective, and do not transgress more than necessary on the nation's fundamental moral values.

KEYWORDS: Thugs, Sikh, Terrorists, Terrorism, Civil Liberties, Human Rights

**STATE AND LOCAL INTELLIGENCE FUSION CENTERS: AN EVALUATIVE APPROACH
IN MODELING A STATE FUSION CENTER**
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In the final report on the attacks of September 11, 2001, the National Commission on Terrorist Attacks Upon the United States (9/11 Commission) found that the attacks were successful in part because information was not shared and analysis not pooled among the different agencies across all levels of government. Since that time, there have been significant strides to improve cooperation and close the intelligence gaps among the different intelligence and law enforcement services. Effective terrorism prevention, however, requires information and intelligence fusion as a cooperative process at all levels of government so that the flow of intelligence can be managed to support the identification of emerging threats to the homeland.

   This thesis explains the value of a state/regional fusion center by examining three successful fusion centers in Arizona, Georgia and Los Angeles. Recommendations from each agency on "lessons learned" as well as independent research have been provided to help state and local agencies develop their own fusion centers.

KEYWORDS: Intelligence Fusion Center, Fusion Center

CITIZEN INVOLVEMENT IN DISASTER MANAGEMENT

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Responding and recovering from large-scale disasters is extremely labor intensive. Unfortunately, a problem confronting all communities is an inability to regularly employ the large number of personnel needed to effectively manage large-scale disasters. One possible solution to increase workforce capacity during times of critical need is for emergency managers to integrate a volunteer component into their existing disaster management plan. The federal government is assisting local communities with volunteer recruitment by nationally sponsoring Neighborhood Watch, Volunteers in Police Service, Medical Reserve Corps, Community Emergency Response Team (CERT) and Fire Corps programs through county-wide Citizen Corps Councils.

The acceptance of volunteers by paid responders can vary significantly from one community to another. The results of a 13 item questionnaire from 50 CERT volunteers from a metropolitan community, who had at least one previous experience working with paid responders during the recovery phase of a large scale disaster, identified that 24 percent felt as if they were in the way, 20 percent felt as if they worked harder than the paid responders, 36 percent were given assignments that did not match their skill level or training, only 48 percent were tasked immediately and only 60 percent reported that paid responders were helpful. It is encouraging that even though some experiences may have been less than optimal, 100 percent reported that they would feel comfortable working with the same responders during another event. In addition, two case studies are used to tell the story of CERT volunteers who assisted with the recovery phase after the 2004 hurricane season in Florida. Each case study concludes with a list of lessons learned, which emergency managers can consider when planning for similar missions.

Primary issues and courses of action are provided to assist community leaders with deciding whether or not volunteers should be integrated into their existing disaster management plans. If the decision is made to integrate volunteers, several recommendations are discussed to assist planners with developing implementation strategies to address the needs and concerns of both volunteers and paid responders.

KEYWORDS: Disaster Management, Volunteer Management, Volunteers, Citizen Corps Council, Community Emergency Response Team, Working Relationships Between First Responders and Volunteers

PERCEPTION OR FACT: MEASURING THE EFFECTIVENESS OF THE TERRORISM EARLY WARNING (TEW) GROUP

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This thesis examines the structure and intelligence process of the Los Angeles Terrorism Early Warning (TEW) Group to assess its effectiveness as measured through the application of a Program Logic Model. This model verifies the links between the assumptions on which the program is based and actual program activities. It further assesses its status as a "smart practice" based on measurable criteria that are beyond perception or peer approval alone. The TEW is a regional, multi-agency and multi-disciplinary network that functions as a focal point for analyzing the strategic and operational information needed to prevent, mitigate, disrupt and respond to threats and acts of terrorism. Although efforts toward prevention are difficult to measure in any program, input and outcome are assessable. This method provides an effective means to evaluate a program while documenting what works and why. Effectiveness should not be based solely on outputs; a structure that produces them is also an indicator. The objective of this thesis is to establish a benchmark of practical standards for collaborative intelligence sharing operations that can be

replicated by other regions and that will establish a common, nationwide, homeland security intelligence network. Based on these criteria, it is reasonable to conclude that the TEW is in fact a "smart practice." It meets its intended goals and objectives when measured according to the parameters of the Program Logic Model, and has a structured process and system that leads to preferred outcomes.

KEYWORDS: Terrorism Early Warning Group, TEW, Intelligence Fusion Center, Information Sharing

TOWARDS A STRATEGIC APPROACH TO SPECIAL EVENTS MANAGEMENT IN THE POST-9/11 WORLD
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This thesis reviews the background related to counterterrorism and law enforcement planning for major special events and identifies some of the strategic issues that have emerged in special events management since the terrorist attacks of September 11, 2001. It focuses on the subjective and objective components of the systems currently used by DHS and the FBI to categorize and resource special events, and it evaluates whether the current approach to major event planning is sufficient for contemporary counterterrorism challenges. The thesis considers how changes in the present system may improve interagency counterterrorism preparedness. Finally, it applies risk management principles to the interagency special event planning process to determine if these principles are useful for developing a rational, politically defensible and fiscally responsible approach to federal resource allocation for major special events.

KEYWORDS: Special Events, Event Planning, Counterterrorism Planning, Risk Perception, Risk Analysis, Risk Management, Law Enforcement, Homeland Security, Strategic Planning, Leadership, Command and Control, Crisis Management, Special Events Management

PREVENTING TERROR ATTACKS IN THE HOMELAND: A NEW MISSION FOR STATE AND LOCAL POLICE
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As the Department of Homeland Security continues to develop plans and strategies to guide government agencies towards a safer environment, state, local and tribal law enforcement agencies are struggling to define their role in the homeland security mission. This paper proposes the creation of a National Law Enforcement Network made up of the state, local and tribal law enforcement agencies throughout the country. The network design will allow local agencies to reach beyond the traditional law enforcement approach by establishing formal networks that facilitate local, regional, national and eventually global coordination of an effective strategy aimed at preventing future terror attacks in the homeland.

The creation of this network will ensure that every police officer in the United States understands their role in preventing future terror attacks. Drilling down to the lowest local level to include businesses, industry and the private sector, the formation of the network expands detection and prevention capabilities well beyond the current level.

KEYWORDS: State, Local and Tribal Law Enforcement, Terrorism Prevention, Local Intelligence Requirements, Threat Detection

SECURITY STUDIES

FROM ROGUE TO VOGUE: WHY DID LIBYA GIVE UP ITS WEAPONS OF MASS DESTRUCTION?

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This thesis analyzes Libya's historic 2003 decision to abandon its weapons of mass destruction (WMD) programs. In the two years following the decision, several theories have emerged to explain why the Libyan regime renounced these dangerous weapons. Current literature and relevant sources are used to analyze the three most probable external causal factors: sanctions and diplomacy, intelligence and coercive diplomacy. It is found that sanctions, diplomacy and intelligence were significant in altering the Libyan cost-benefit analysis in favor of the West. These findings have political and theoretical implications. Lessons learned from the Libyan case are not effective against Iran and North Korea due to differences between these countries' proliferation motivation levels and the Libyan case. However, the influence strategies that were effective against Libya are likely to be applicable in other situations. More research is needed to identify the conditions under which different strategies are most likely to be effective.

KEYWORDS: Libya, Qadhafi, Weapons of Mass Destruction, Proliferation, Diplomacy, Sanctions, Intelligence, Coercive Diplomacy, Influence Strategies

SAFETY RISK MANAGEMENT FOR HOMELAND DEFENSE AND SECURITY RESPONDERS

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Responders at the federal, state and local level are critical to homeland defense and security (HLDS). Building from the recently published RAND and National Institute of Occupational Safety and Health (NIOSH) report on responder safety, this thesis explores the issues associated with creating a safety risk management capability that will enable HLDS responders to better protect themselves from harm and enhance their readiness. Risk management experiences within the military are benchmarked with emphasis upon lessons learned from the U.S. Coast Guard and the U.S. Navy. This reveals that Operational Risk Management (ORM), a risk-based decision making tool that systematically balances risk and mission completion, and Crew Resource Management (CRM), human factors-based team coordination training, should be the primary components considered in building the safety risk management capability. Development of ORM and CRM capabilities for HLDS responders will require strong national and local leadership, innovative measurement tools, and clear accountability, and should be implemented via the national preparedness model outlined in Homeland Security Presidential Directive 5 (HSPD-5) and HSPD-8. ORM and CRM, if successfully established, can provide HLDS responders with the safety risk management capability that will enable them to safely and effectively provide their vital services to the nation.

KEYWORDS: Risk, Risk Management, Operational Risk Management, Emergency Management, Emergency Response, National Preparedness Goal, National Response Plan, National Incident Management System, Incident Command System, Universal Task List, Target Capabilities List, ORM, CRM, NPG, NRP, NIMS, ICS, UTL, TCL, Safety, Crew Resource Management, Team Coordination Training, Human Factors

SECURITY STUDIES

HOW CAN WE IMPROVE INFORMATION SHARING AMONG LOCAL LAW-ENFORCEMENT AGENCIES?

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The events of 9/11 and subsequent examination of the intelligence community in the United States have clearly identified several areas that require immediate repair. A complex system of collecting, developing and analyzing intelligence that can be used to prevent terrorist attacks already exists on the federal, state and local levels, although there is no accompanying system that shares intelligence information throughout the law enforcement community.

The purpose of this thesis is to review information sharing between federal, state and local law enforcement agencies and to suggest methods to improve that capability. In the aftermath of the September 11th attacks, authorities uncovered patterns of suspicious activity occurring in places such as Maryland, Florida and New Jersey. These activities included individuals paying cash for plane tickets, taking flight lessons, inquiring about crop duster planes and frequenting drug stores.

Taken individually, these incidents were not overly suspicious; nor were they seen as serious when reported to authorities. Yet, all together they illustrate at best highly suspicious behavior, and at worst a picture of a master plan of prospective criminal activity. When collecting data on terrorist potential, one isolated incident in a local jurisdiction may not have obvious significance, but the ability to view all incidents together across cities or states might paint a more complete picture. Agencies are now recognizing the benefits of data sharing across institutions and jurisdictions.

The success of the fusion center concept rests in the ability of the Office of the Director of National Intelligence, the Department of Homeland Security and the FBI to make a collaborative decision on what system(s) would best meet these requirements.

KEYWORDS: Information Sharing, Intelligence Sharing, Local Law Enforcement, Terrorism Working Group, Fusion Center

INTELLIGENCE REFORM AND IMPLICATIONS FOR NORTH KOREA'S WEAPONS OF MASS DESTRUCTION PROGRAM

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This thesis analyzes the current intelligence reform initiatives in light of multiple recommendations from post-9/11 commissions tasked with studying intelligence shortcomings. Using North Korea as a case study, it examines how reform efforts will increase capabilities to better understand Pyongyang's weapons of mass destruction (WMD) programs and affect U.S. strategy on North Korea.

Three reform sets should significantly improve U.S. understanding of North Korea's WMD programs. Collection reforms should allow intelligence agencies to gather more information to gain increased insight into Pyongyang's WMD programs. Analysis reforms will develop alternative methods and create streamlined procedures to avoid failures such as those witnessed in Iraq. Collaboration reforms should enable the Intelligence Community to shed its "stovepipe" mentality, facilitating unity of effort in reducing intelligence gaps on North Korea's dangerous programs.

Intelligence reform, while necessary, is insufficient to deal with the North Korean threat. An engagement strategy could help the intelligence community better understand North Korea and its WMD programs by bringing Pyongyang into the international fold and lowering its isolationist tendencies.

Engagement could increase intelligence collection opportunities and give decision makers more relevant information, yielding better decisions and improved counter proliferation efforts. Finally, ongoing reforms should better equip policymakers to tackle broader issues, such as terrorism and counter proliferation.

KEYWORDS: North Korea, Intelligence Reform, Weapons of Mass Destruction, 9/11 Commission, Intelligence Reform and Terrorism Prevention Act of 2004, Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction

THE PATH TO TERRORIST VIOLENCE: A THREAT ASSESSMENT MODEL FOR RADICAL GROUPS AT RISK OF ESCALATION TO ACTS OF TERRORISM
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In this thesis, a threat assessment model to identify domestic radical groups on a trajectory towards terrorist violence is presented. The current lack of a valid and reliable assessment model constrains proactive counter-terrorism efforts, resulting in largely reactive strategies that are often ineffectual in discovering and disrupting terrorist plots while in an inchoate stage. The Path to Terrorist Violence Model, based on a threat assessment model used in the emerging field of threat management for the judiciary and elected officials, is a useful assessment methodology to identify radical groups at risk of escalation to acts of terrorism. By focusing on attack-related behaviors that a group must take to mount a planned attack, the Path to Terrorist Violence Model avoids contentious issues related to psychosocial, religious, race or ethnicity-based profiling assumptions.

KEYWORDS: Threat Assessment, Radical Groups, Terrorism, Path to Terrorist Violence, Threat Model, Symbionese Liberation Army, Army of God, Animal Liberation Front, Pro-Life Violence, Counter Terrorism, Disrupting Terrorist Conspiracies, Intended Violence, Targeted Violence

COMMAND RESILIENCY: AN ADAPTIVE RESPONSE STRATEGY FOR COMPLEX INCIDENTS
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Many organizations believe they are prepared for the next terrorist event by wrongly assuming there is a predictable threat that can be managed with the purchase of new equipment. Unless organizations develop a resilient response strategy that can adapt organizational and operational elements to respond to new terrorist incidents, they will find themselves with the same difficulties emergency responders faced on 9/11. As terrorist attacks unfold, organizations are pushed beyond their normal capabilities. How quickly organizations adapt to the uncertainty of a new crisis is critical. Organizations that cannot adapt to new threats of large, complex terrorist events will be less likely to respond effectively to future attacks.

Recommendations are provided for a resilient response strategy that is flexible enough to adapt to complex incidents. Policy recommendations that address organizational strategy and operational crisis management to deal with the initial critical hours of a terrorist attack are proposed. Organizational strategy defines core competencies and what happens when competencies are pushed beyond their capacity. Operational crisis management examines situational awareness requirements, flexible decision making and innovation. Command resiliency is achieved by overcoming organizational bias and integrating organizational preparedness and operational adaptability into a synergistic response network.

SECURITY STUDIES

RESOURCE SHARING: BUILDING COLLABORATION FOR REGIONALIZATION

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The major challenge in securing the homeland is to provide for all citizens effective and capable prevention and responsiveness to chemical, biological, radiological, nuclear and explosive events. States have different homeland security organizational structures, priorities, funding strategies and implementation methods. Consequently, the nation lacks a clear, uniform prevention and response strategy that translates into an overall capability that cannot be qualitatively defined. To combat this situation, the Department of Homeland Security (DHS) has linked future funding to implementation of a holistic approach to homeland security program strategies, which include implementing intrastate and interstate regional approaches that effectively leverage resource sharing. North Dakota responded to funding reductions by addressing its first comprehensive statewide regional plan to develop a more efficient and effective homeland security program; however, actual implementation was not realistic. A tiered approach to sharing resources through regionalization means jurisdictional capability levels will be thoroughly examined and homeland security allocations distributed accordingly. Local jurisdictions in North Dakota exhibit very independent attitudes; instituting regionalization, which changes levels of funding, is controversial. Therefore, it was vital to first devise a plan that determined statewide acceptability for a regional approach. It was also deemed necessary to develop standardized baseline equipment lists corresponding to each of the four levels of weapons of mass destruction (WMD) capability as defined by DHS. The baseline lists provide specific guidance, direction and clarity for equipment purchasing decisions and circumvents the complex and disjointed method currently in use.

COMMON CHEMICALS AS PRECURSORS OF IMPROVISED EXPLOSIVE DEVICES: THE CHALLENGES OF DEFEATING DOMESTIC TERRORISM

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During the past decade, the world has witnessed an increase in the use of improvised explosive devices (IEDs). Explosives in the hands of terrorists continue to pose a significant threat. Lessons learned indicate that when traditional explosives become difficult to obtain, bomb makers turn to common chemicals as precursors to manufacture explosives. Only the imagination and the availability of certain chemicals limits the number of explosives that can be manufactured with relative ease, utilizing common chemicals readily available in the community. Availability of precursor chemicals and ease by which explosives can be manufactured increases the potential that IEDs will be deployed in the homeland and requires a careful study of the options necessary to defeat IED deployment.

This thesis analyzes various options, policies and procedures to ascertain which would be most appropriate to defeat explosives manufactured from common chemicals. Options include removing, restricting and tracking certain chemicals available to the public, and increasing awareness of emergency

responders and the public. State and federal legislation pertaining to methamphetamine laboratories is analyzed to identify potential crossover legislation to counter explosives manufacture. Intelligence gathering and information sharing technologies and procedures are assessed for effectiveness as law enforcement tools.

KEYWORDS: Improvised Explosive Devices, IED, Explosives, Common Chemical Precursors, Information Sharing, Relational Database, Domestic Terrorism

THE JUST WAR OR JUST A WAR? A PROPOSAL FOR AN ETHICAL JOINT WARFIGHTING DOCTRINE
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According to joint doctrine, winning the nation's wars is the primary purpose of the armed forces. It is the foundation of joint professional military education and training, forming the basis for how the warfighter will prosecute a war, and is a reflection of the judgments of senior military leadership. The joint and service warfighting doctrine of the 1940s and 1950s contained two aspects of war that are not reflected in current joint doctrine. Combat now spans both war and "not war" in the new "military operation other than war," and the process of the military government has been completely replaced by the new "civil administration." This two-part redefinition of war has created a new joint doctrine that is confusing, overlapping, compartmentalized and incomprehensible, and has resulted in many military failures in the decades since World War II. In general, the second tenet of the Just War Theory dictates that the weak must be protected throughout the war effort. International law of occupation states that certain functions and institutions of the defeated nation must be restored by the occupying power. The military government, such as those found in past wars administered by the U.S. armed forces, is the vehicle to ensure that the war is prosecuted justly and done so in a manner that will win the peace. This thesis recommends a return to a holistic continuum of war in two phases, formal hostilities and the post-formal transition to peace, which adheres to international law, incorporates all combat as "formal hostilities," is independent of size or scope and requires the armed forces to win the peace as they have successfully done in the past.

KEYWORDS: Joint Warfighting Doctrine, MOOTW, War, Peace, Just War, Professional Military Education, War With Mexico, U.S. Civil War, Japan, Germany, Philippines, Conundrum, Civil Affairs, Civil-Military Operations, Post-Conflict Transition to Peace, Stabilization and Reconstruction, Joint Publications, Holistic

CONVENTIONAL PROMPT GLOBAL STRIKE: VALUABLE MILITARY OPTION OR THREAT TO GLOBAL STABILITY?
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This thesis examines the potential destabilizing implications of conventional, prompt, global strike capabilities that operate from or through space. Existing material on this subject is largely limited to debates over the merits of terrestrial versus space basing and arguments against deployment over perceived increases in the likelihood of inadvertent nuclear war. This thesis addresses these issues, but takes the next step and analyzes the root causes and proposes possible solutions to the "security dilemma" these weapons may create. The central finding is that in order to fully exploit the predicted advantages of conventional prompt global strike capabilities, significant changes to the enduring Cold War nuclear postures of the United States and Russia are necessary.

**HOMELAND SECURITY KNOWLEDGE MANAGEMENT FOR LOCAL
LAW ENFORCEMENT IN THE NATIONAL-CAPITOL REGION**
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Within the last three years, Homeland Security (HLS) has emerged as a new focus for local law enforcement agencies throughout the nation. While local police must effectively address community needs associated with crime and quality of life, they are also now on the front lines of the nation's battle against the forces of international terrorism. Using existing knowledge (derived primarily from the emergency management field), police agencies have worked to develop locally relevant, viable and available expertise in the developing field of HLS. If federal estimates are accurate, however, a critical mass of these experts will retire within the next five years. As these organizational experts approach retirement, their communities will be forced to deal with the consequences of an exodus of fundamental knowledge, experience and expertise. Police organizations will be challenged to continue the efficient delivery of homeland security services absent the experts who were instrumental in developing the field. Existing research in Knowledge Management (KM) may offer some guidance to managing this problem. KM seeks to offer organizational guidance on how to identify knowledge generation processes and then leverage, maintain and manage knowledge assets within an organization. This thesis seeks to explore the potential application of KM theories to the real challenges faced by local police agencies in the National Capitol Region as they attempt to effectively engage HLS management.

KEYWORDS: Knowledge Management, Homeland Security, Public Safety

STUDENT INDEX

ADVISOR INDEX

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